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The Report and the Recommendations of the Commissioner of Patents.

The annual report of the Commissioner of Patents, some account of which is given in another column, is an interesting as well as a valuable document. The written portion has the merit of being so short that anyone interested in it can go through it in a quarter of an hour, and at the same time it is full of information and pertinent suggestion. The impression it conveys, and no doubt truly, is that the Patent Office has not been fairly treated by our national legislators. The story of the salaries of the stenographers and the humiliating proposition with regard to the library it should not have been necessary to write. The desired legislation which the Commissioner mentions should receive full and fair consideration.

His recommendations and his remarks, explanatory or otherwise, are as follows, with some omissions of superfluous matter:

"1. An amendment providing for the appointment of Commissioner and Assistant Commissioner of Patents for a stated term, which should not be less than six years.

"The duties they are called upon to perform are largely judicial in character. . . . A definite term will give stability to the office practice, which is sadly needed. Since 1870 there have been fourteen Commissioners, or, in other words, a new Commissioner about every two years.

"2. An amendment to limit the life of all patents, so that they shall expire not later than twenty years after the applications for the same are filed.

"At the present time it is possible to keep applications alive for an indefinite number of years. That this practice does not promote the progress of invention is self-evident.

"3. An amendment permitting aliens to file caveats.

"By so doing we may hope to receive certain important concessions from some foreign countries.

"4. An amendment providing for the publication of 3,000 copies of the "Official Gazette" of the Patent Office, to be apportioned among Senators and Representatives in Congress, by them to be distributed among manufacturers and mechanics.

At the present time 7,000 copies of the "Official Gazette" are printed, and it is believed that 3,000 additional copies can be furnished for a sum very little in excess of that now paid for the 7,000 copies.

"5. A statute to provide for the registration of trade-marks used in interstate commerce.

. . . . . .

"6. An amendment providing a fee of five dollars for petitions in interlocutory proceedings to the Commissioner of Patents."

Of these amendments, with our knowledge of the habits of Congress, probably No. 4 is most likely to be adopted, and when the 3,000 additional copies are printed the cost of postal conveyance would be saved by throwing them into the Potomac. They would be likely to do as much good there as if distributed in the way that Congressmen usually distribute public documents.

If any important concessions from any foreign countries can be secured by amendment No. 3 it will be getting them very cheaply. So far as American inventors are concerned, the caveat system is worse than worthless, for it does no one any good, while it deludes those who are ignorant of its workings. We most heartily indorse Nos. 1 and 2.

Our Letters From Practical Men.

We frequently receive, sent in by writers hitherto unknown to us, welcome and valuable contributions upon shop matters as seen from within the shop, or narratives of shop experiences in which the narrators have participated, and these are often accompanied by statements that the writers have been for many years diligent and appreciative readers of our pages, that they have imbibed thereby a constant flow of valuable information pertaining to their special lines of industry, that they have profitably adopted many ideas and suggestions that have thus come to them, that in general our companionship has been both guiding and stimulating, and that much more than an equivalent for the subscription price has been received. Two striking confessions of this kind have come to us quite recently, and it is not necessary to say that they are gratifying. To the contributions of those of our old readers and thinkers who thus at last wake up and send us something in return for all that they have been receiving we are always ready to say that they are very much "better late than never," but we still cannot entirely repress our regret over the lateness of their arrival. And then comes the conviction that there are still others from whom we have not yet heard at all, but from whom we and our readers ought to hear. If we are to hear, the initiative must be with them. The correspondence cannot possibly begin except at the other end. We cannot know the personnel of every shop, nor the details of what goes on within it, unless some word of it first comes to us. Every machine shop, foundry, blacksmith shop, boiler shop, tool room, drawing room, engine room, or what not, is different from every other. What is done and to be done in these places is in each one different in some particular from that of every other; in each of them the men are different, and in most of them are thinking men, men who find satisfaction in accomplishment and are continually, consciously and unconsciously, planning to do more and better. Originality and progress are scattered broadcast; good work is being done everywhere, and better to-day than

yesterday. Those who do good work know well enough when they do it, and they not only like to get well paid for it, but they like to find appreciation, and it is our mission to satisfy them as we have opportunity. What we like best of all, and what our readers also prefer, is information concerning things actually done, and the ways and means for doing them. This is always preferable to anything in the way of speculation about what might be done or how it might be done. When things are to be done, especially something novel or difficult, it is then most proper to consult as to the way. Our department of "Letters from Practical Men" is the place for these things. It is never without good material, but there is always room for much more, even to the crowding out of perhaps more pretentious matter. Our readers, old and new, can do more than appreciate it. They can help it along by their contributions. There are lots of things spoiling to be told, and we are waiting to welcome them. There is nothing required but the overcoming of a little inertia, and we "pay the freight."

The Speed of Air Compressors.

BY FRANK RICHARDS.

The following letter has been handed to me:

"I have never seen in the 'American Machinist' any discussion as to the proper speed of an air compressor. What speeds are and what are not practicable? It is obvious to those who have looked into the matter that the speeds of air compressors are commonly low, but whether this is imperative, or whether it is only that present practice has not yet reached the permissible speeds, is the question, and if much higher speeds may yet be employed, what are the present hindrances and what the most promising means for overcoming them? These things seem to me to offer a very good field for useful statement and discussion, and I should be much interested, and I believe many others would be, if the subject were taken up in your columns. A SUBSCRIBER."

The utimate speed of an air compressor, like that of a steam engine, is the result of a compromise. It is of course desirable that any machine shall accomplish as much as possible, and the inevitable impulse is to speed it up. There is, however, always reached a limit beyond which the speeding up ceases to be profitable. None can be more interested in developing the highest efficiency in any class of machinery than the builders of such machinery, for those who can show the highest efficiency have the best of the argument with the customer. In their search for the higher efficiencies the builders also, if in healthy communcation with the users of their machinery, have the best opportunities for learning the conditions, including in this case that of piston speed, which limit and determine the capacity. When the builders publish tables of data concerning their air compressors of different sizes and styles, including piston speeds and volumes of air compressed, we may assume that they speak from the most reliable knowledge, and that they are at the same time disposed to make as good a showing as possible. I have before me the catalog of one of the largest and most successful builders of air compressors, in which are given the piston speeds of a large number of their machines. These speeds range from 150 feet to 620 feet per minute, the former being for little machines of only 6-inch stroke, and the latter for the largest Corliss engine compressors of 5-foot stroke.

Now, it is rather a matter of taste as to what we shall call fast and what we shall call slow. Our correspondent above would call these speeds slow, while I would not. Steam-driven air compressors usually have no governors or speed regulators, so that they may be speeded up by simply turning the throttle wheel, but not with all-around satisfaction. A large increase of speed will usually give but a small increase of delivery, and the valves and working parts of the machines suffer rapid wear or frequent breakage. Air compressors are often installed for a single job, as for operating rock-drills where a long tunnel is to be driven or a deep shaft sunk, and here little care is given to the compressor if it will but stand by the job to completion, and damage to it is little thought of if large volumes of air can be delivered, and in such service the speed limits of air compressors have been thoroughly, if not closely, ascertained.

The objections to high speed for an air compressor begin, right at the beginning, with the operation of getting the air into the cylinder. During the intake stroke, as the piston recedes the air is, of course, driven into the cylinder by the pressure of the external atmosphere. To cause the air to flow in there must always be a difference of pressure between the inside and the outside of the cylinder, and the pressure outside can be nothing more than the normal atmospheric pressure, so that the pressure within the cylinder on the intake stroke must always be something less than this. To increase the velocity at which the air must flow in, and especially to start the flowing of the column of air more frequently, as must be done when the speed is increased, demands a greater difference between the internal and the external pressures, or a reduced pressure within the cylinder, and this must mean that a less weight of air will constitute a cylinderful, and less air will be compressed and delivered per stroke.

An additional loss is entailed by an increase of speed in the case of the two-stage compressor, as it must necessarily affect, and always disadvantageously, the efficiency of the intercooler. The intercooler is the only justification of the two-stage compressor, and a two-stage air compressor without an efficient intercooler is a mechanical absurdity. Power is saved by cooling the air after it is partially compressed and so reducing the volume to be operated upon in the second cylinder. The best intercooler at its best is not too efficient, and as when the speed of the compressor is increased the heated air must pass through it more frequently and more rapidly, it cannot be as completely cooled.

An increase in the speed of the air compressor means also increased difficulty in properly lubricating the cylinder. With an initial temperature of 60 degrees Fahrenheit, the final temperature of the air in the cylinder of a single-stage air compressor when delivering air at, say, six atmospheres is above 400 degrees, while in the first cylinder of a two-stage compressor it is nearly 300 degrees, so that the difficulty of maintaining proper lubrication may easily be appreciated. The water jacket may not count for much in its effect upon the air within the cylinder during the compression stroke, but it is of great service in keeping the inner surface of the cylinder at least cool enough to prevent the actual burning of the oil. This service is quite seriously impaired if the piston speeds are much increased. The failure of the lubricant, and the burning and cutting of the cylinder and valve surfaces are familiar and costly experiences accompanying the reckless speeding up of compressors.

There is positive danger in running a compressor at such a speed that the air cooling devices employed do not have sufficient time to do their work completely. Serious explosions have been caused by the ignition of mixtures of oil vapor and air in the cylinders or other parts. One such accident occurred within my knowledge quite recently, in which the intercooler between the cylinders of a compound compressor was blown to pieces, and an important service was interrupted for a long time in consequence. In some cases men have been killed by similar accidents.

And then there is the trouble with the pounding of the valves. The maintenance of the valves of the compressor is usually the largest item of repairs. They are usually poppet valves, and the elasticity of the air causes them to move in both directions at a lively gait and to strike hard, and of course this is much worse at high speeds. There may yet be devised valves with sliding movements that will avoid some of the most objectionable features of the poppet valves, and, so far as they are concerned, make somewhat higher speeds permissible, but they will be more than likely to bring other troubles in their train as great as those which they attempt to cure, and especially in the difficulty of proper lubrication.

Thus there are several particulars to be suggested which tend to limit the profitable speed of the air compressor. They are none of them of a character to be handled

with figures and formulas, but experience speaks with sufficient clearness and sharpness in the matter. It is not probable that much higher speeds will be established for air compressors than those now prevailing. The limit will, of course, be where it does not pay, all things considered, to run any faster.

Commercial Review.

NEW YORK, SATURDAY EVENING, February 3, 1900.

MACHINISTS' SUPPLIES, ETC.

The first month of trade in 1900 may be characterized by the epithet "conservative," using that term in its better sense, denoting a maintenance of existing conditions, rather than with the meaning so often attached to it, of dullness and lassitude. The market for supplies has developed no surprises, either in the way of improvement upon last year's activity or reaction therefrom. Business is good, and better than it was a year ago, though not equal to what it has been in the meanwhile. There is now little difficulty in obtaining goods from factory. Prices are still firm in most lines and without much disposition to advance. The most noteworthy increase that has lately been made is upon twist drills.

A meeting of twist drill manufacturers was held in New York February 1, and it was decided to advance prices 5 per cent.

A matter which it is understood came up for discussion at this meeting was the underbidding of schedule price for drills on recent government specifications. The Naval Bureau of Supplies and Accounts opened proposals for a great quantity of supplies for various yards January 23. There was a lot of drills which, it is claimed, would have amounted at the schedule rate to $2,835, but the bids, seven in number, were all under this figure, the lowest being $2,498.47. The bidders were jobbing firms, some of whom make a specialty of government contracts. In no case did manufacturers of drills bid directly, and what makes of drills would be furnished under the several proposals is not known.

To underbid the market on government contracts is of ordinary occurrence, and it does not necessarily denote weakness of values in general trade.

Twist drills are a favorite bone of contention between manufacturers and jobbers, and the jealous attempts to break or to sustain prices are more energetic than in other lines. Jobbers sometimes employ the cuts in government awards as "bear" arguments, after the manner of Wall street operators, for the purpose of demoralizing figures, but experience shows these arguments to be in great part a sophistry. Still manufacturers do not want the schedule to be broken even for government contracts if they can help it, and should it be proved that any manufacturer was secretly backing up the bidder at prices below the standard he would probably be administered with such punishment as his fellow manufacturers were able to inflict. The way in which these low offers were rendered possible, however, may in every case be that the bidders have had outstanding contracts with the manufacturers at old prices, which have enabled them to lay in heavy stocks and offer the drills at less than schedule figures. Were it not customary to cut prices in government contracts the result would be peculiar, since any manufacturer ought to be willing to sell to the government at schedule rates. The award would then resolve itself into a matter of preference, based upon adequate tests or otherwise.

It may be mentioned that one jobbing firm tells us that it has computed the amount of the contract at schedule rates to be $2,747.17, but the figures $2,835 are derived from good authorities. Mistakes of computation are frequently made in putting in estimates on government contracts, and it is rumored that the cutting of prices so much in the present case is due to clerical inaccuracy.

POWER TRANSMITTING MACHINERY.

The question has probably suggested itself to many, How important is the present and probable future effect of electrical power distribution upon the business of makers of belt transmission apparatus? A wholesaler of wood split pulleys states in this connection that the trade of his company has not suffered seriously from that cause. Competition of this sort has been felt chiefly in the West, and there it has been serious only in certain spots, where, owing to the economy of obtaining an electric power supply the system has obtained vogue. Denver, Colo., is such a place, for example. There is not much manufacturing in that city, but machine shops for the repair of mining tools, besides printing offices, are important in an industrial way. With the increased transmission of the Niagara Falls current to Buffalo, that city will become an electrical one. When such a district is encountered the pulley people concentrate their chief attention upon other fields which can be cultivated with more hope of success. The manager of another power transmitting machinery office estimates that the business of his concern has not as yet been injured one-tenth of one per cent. by electrical apparatus. Such harm as has been done is chiefly through the employment of direct couplings of dynamo to engine instead of belts. Where motors are used for driving tools in groups, about as much counter shafting is needed as with the old method. Factories where direct connection of motors to each tool is employed, the speaker considers exceptional. Whether the company will ultimately find it politic to adapt itself to changed conditions by adding motors and other electrical transmission apparatus to its lines is regarded as a far-ahead and uncertain matter.

"You tell your readers," says a power transmitting machinery man, "that if they have orders to place they would better hurry up and do so. Next summer, I believe, they will have to wait longer for apparatus than ever before." This is putting it stronger than the average authority would do, but we feel that it was spoken candidly from the standpoint of the concern from which it emanated. The power transmitting machinery business is certainly very active, and the amount of work in sight is gratifying. Crowded manufacturers have still to pursue a selective policy in their competition for orders. A sizable contract is understood to have been turned down very recently by makers not in a position to take it. One house, nevertheless, finds this to be a business interval devoted to finishing up work for buyers who arranged last year for the requisite equipments of their factories, and to looking forward to the new business that is in sight.

The boom in cement mill erection is attracting the attention of the Webster Manufacturing Company, who speak with emphasis of the great quantity of such work now going ahead and coming in sight. The company has lately closed contracts to equip with transmission machinery, etc., a 1,000-barrel plant of the Wabash Portland Cement Company, Helmer, Ind., and one of the Peerless Portland Cement Company, Union City, Mich. Nearly twenty gas and gasoline engines have been sold by the company in the last two weeks, one of them for Milan, Italy. The importance of the 6,000,000-bushel grain elevator equipment which the company has contracted to furnish to the Great Northern Railway Company for West Superior, Wis., may be judged from the fact that the largest existing elevator that could be recalled was of 2,500,000 capacity.

A PROSPEROUS EXPORT TRADE.

Mr. E. B. Hotchkiss, manager of the Brussels branch of the firm Adolphe Janssens, Paris, has been in this country since November 10, and returns to Europe February 7 on the "St. Paul." While here he has attended to the execution of contracts amounting to some $700,000, which the house had already placed in this country, and has given out orders for tools amounting to nearly $800,000 more for its general trade and stock. Trade conditions and long deliveries make it necessary to place large orders to keep up a stock that will meet requirements, considering the rate of turnover. Inquiries abroad are the best on record. The house proposes to carry as large and complete a line as any of its competitors. It now has three machine tool stores in Paris, one of them having been opened recently, a branch lately established at Lille, an increased showroom at Brussels, a large warehouse at

Antwerp soon to be ready, and a branch in Switzerland under negotiation.

Among the companies with which Mr. Hotchkiss has contracted for tools during this visit are the Cincinnati Milling Machine Company, with whom notably large orders were placed, the Bickford Drill and Tool Company, Landis Tool Company, Niles-Bement-Pond Company, Prentice Brothers Company, Bullard Machine Tool Company, Potter & Johnston Company, Warner & Swasey, New Haven Manufacturing Company and J. A. Fay & Egan Company.

Orders had already been placed for tools for the equipment of the locomotive works of the Société d'Energie, at Couilet, near Charleroi, Belgium. This equipment will amount to about $200,000, the greater part being of American make, though there are some English machines for special purposes which the American are not particularly adapted to meet. Locomotives on the Mackintosh plan will be built to start with, the initial capacity of the works being 100 a year, but it is the purpose ultimately to build locomotives on the American plan, which has been studied up by engineers for the works. The tools that were ordered in the United States comprise boring mills, large and small, lathes of 12 to 60-inch swing, planers, plate-bending and straightening machinery, pneumatic tools, etc.

The house has a number of good-sized contracts now under way, including another large locomotive works. Some orders have been taken for shipbuilding purposes in Russia on the Black Sea. Certain large gun and projectile works are buying. Automobile manufactories constitute quite a feature. There is a steadily increasing trade in tools for this purpose. On the Continent the automobile industry has already become a more important one for machine tools than bicycle manufacture ever was.

Mr. Hotchkiss will take back with him a mechanical expert, who will go about to all of the shops equipped by the firm to instruct operators on methods of handling special machines and superintend the erection of large tools.

EXPORTS FOR 1899—REPORTED SHIPMENTS OF METAL-WORKING MACHINERY, $6,840,924.

The "Monthly Summary of Commerce and Finance," compiled by the Bureau of Statistics, Treasury Department, for December, 1899, completes the totals for the calendar year. The reported shipments of metal-working machinery for the month, as well as for the year, were the heaviest on record. In fact, the year was a better one than either 1898 or 1897 for all classified lines of machinery, except locomotive engines and shoe machinery.

Metal-working machinery exports for the month of December, 1899, were $748,654; December, 1898, $419,884; November, 1899, $569,406; year 1899, $6,840,924; year 1898, $5,741,750.

Electrical machinery exports were: December, 1899, $385,350; December, 1898, $247,447; November, 1899, $303,476; year 1899, $3,143,336; year 1898, $2,523,644.

Printing presses and parts thereof: December, 1899, $115,024; December, 1898, $105,304; November, 1899, $134,533; year 1899, $1,037,644; year 1898, $843,688.

Pumps and pumping machinery: December, 1899, $304,536; December, 1898, $286,340; November, 1899, $246,095; year 1899, $3,016,645; year 1898, $2,300,811.

Locomotive engines: December, 1899, 22 in number, at $223,500 aggregate value; December, 1898, 27, at $268,593; November, 1899, 28, at $271,500; year 1899, 487, at $4,767,850; year 1898, 576, at $5,190,782.

Stationary engines: December, 1899, 66, at $38,912 aggregate value; December, 1898, 50, at $27,957; November, 1899, 91, at $68,270; year 1899, 870, at $494,939; year 1898, 522, at $352,668.

Boilers and parts of engines: December, 1899, $134,798; December, 1898, $58,192; November, 1899, $168,279; year 1899, $1,439,363; year 1898, $1,145,508.

Fire engines: December, 1899, none; December, 1898, none; November, 1899, 1, at $8,135; year 1899, 4, aggregating $21,848; year 1898, 7, aggregating $6,588.

Typewriting machines and parts thereof: December, 1899, $243,245; December, 1898, $183,917; November, 1899, $215,107; year 1899, $2,776,363; year 1898, $2,077,250.

Sewing machines and parts thereof: December, 1899, $415,281; December, 1898, $237,836; November, 1899, $427,148; year 1899, $4,103,828; year 1898, $3,062,471.

Shoe machinery: December, 1899, $85,333; December, 1898, $85,306; November, 1899, $83,465; year 1899, $961,736; year 1898, $939,671.

Cash registers: December, 1899, $53,776; November, 1899, $61,185; six months ending December, 1899, $421,141.

Laundry machinery: December, 1899, $34,933; November, 1899, $31,066; six months ending December, 1899, $182,832.

Miscellaneous machinery and other manufactures of iron: December, 1899, $1,949,033; December, 1898, $2,198,118; November, 1899, $1,837,143; year 1899, $19,721,191; year 1898, $16,413,893.

The increase in this miscellaneous class is probably a little greater than appears from the figures, since cash registers and laundry machinery were removed to classes by themselves last July.

The imports of machinery into the United States amounted to $2,185,566 for 1899, as compared with $1,930,436 for 1898. The total imports of iron and steel and their products, not including ore, were $15,799,206 for 1899, against $12,474,572 for 1898.

CHICAGO MACHINERY MARKET.

Not only in the equipment of shops and factories, but in every line of development, the electrical industries appear to be very active throughout the West, from the largest down to the smallest work. There are several inquiries now out and estimates asked for to change cable to electric power in extensive street railway work. Projects for new electric railways are numerous. Telephone work in cities, villages and country is taxing the capacities of plants devoted to that line of manufacture. Producers interested in supplies for automobile makers are doing a most thriving trade. The circumference of the electrical field is slowly widening, and the territory was never more efficiently cultivated than now.

The makers of generators and motors are not borrowing trouble in respect to the volume of trade. It continues to be largely a question of deliveries. Some representatives say business is not so good as during the closing months of 1899. But the common report is that a great deal of business is in sight. And not a little has been closed during the first month of the year. Prices are without special change, though somewhat irregular. Failures to secure contracts seem to be pretty well distributed, as well as successes, and with works so well sold into the future as they are, missed opportunities are not keenly lamented. The pending labor trouble at Chicago is to a marked degree depressing the trade in new construction in this city, and for the moment most of the business being closed is for outside points.

Quotations.

NEW YORK, Monday, Feb. 5, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:	
No. 1 X foundry	$24 20 @ $25 00
No. 2 X foundry	23 20 @ 23 70
No. 2 plain	22 20 @ 22 70
Alabama Irons:	
No. 1 foundry	22 50 @ 23 00
No. 2 foundry	21 50 @ 22 00
No. 3 foundry	20 50 @ 21 25
No. 1 soft	22 50 @ 23 00
No. 2 soft	21 50 @ 22 00
Foundry forge	19 75 @ 20 75

Bar Iron — Base sizes — Refined, mill price on dock, 2.20 @ 2.35c.; store price, 2.50 @ 2.60c.; common from store, 2.45 @ 2.50c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.85 @ 3c.

Cold Rolled Steel Shafting—Base sizes—From store, 4 @ 4¼c.

Copper—Lake Superior ingot, 16¼ @ 16½c.; electrolytic, 16 @ 16⅛c.; casting copper, 15⅞ @ 16⅛c.

Pig Lead—Wholesale lots, 4.70c., New York delivery; carloads, 4.72½ @ 4.75c.

Pig Tin—In 5 and 10-ton lots, f. o. b., New York, 29c.

Spelter—Prime Western, 4.75 @ 4.80c., New York delivery.

Antimony — Cookson's, 10⅞ @ 11c.; Hallett's, 9¾c.

Lard Oil—Prime City, present make, 51 @ 53c. in jobbing lots.

The Machinery and Transportation Building at the Pan-American Exposition.

The Machinery and Transportation Building of the Pan-American Exposition to be held in Buffalo in 1901 will be 500x 350 feet, and, as the illustration shows, has been designed in a type of Spanish Renaissance, based somewhat upon the mission buildings found in Mexico and in California. The building forms a hollow square, with arcades on all sides. The interior is a court, 100x200 feet, adorned by a long pool of water, with fountain, shrubs and flowers. The roof is of red tile, the walls of cement, ornamented and colored. The facades present an arcaded effect, and the eaves have the characteristic great overhang. The openings are grilled with specimens of wrought-iron "Regas," or grill screens, such as are seen in examples of Spanish architecture of the sixteenth century. The building has numerous entrances, the principal ones being in the center of the four facades.

MACHINERY AND TRANSPORTATION BUILDING, PAN-AMERICAN EXPOSITION.

Calculations for a Crane Girder.

BY A. D. WILLIAMS.

The problems of girder designing may seem to be outside the field of the "American Machinist," but as a part of the overhead traveling crane girders have invaded the machine shop, the accompanying calculations for a crane girder may be of interest. They are arranged systematically for preservation in an ordinary letter file, where they can be easily referred to. Girder work, where the item of time counts, demands the use of all available means for cutting down the work, and there is nothing more effective for this than a record of past work, which, in the hands of an experienced man, will, in many cases, result in the selection of an economical section at the first trial. The properties of a section require quite a little time in their calculation, no matter what tables and short cuts are used, and any changes will result in an entirely new section which requires a fresh start from the beginning. Experience counts for a great deal also, as it permits the making of assumptions that tally very closely to the figures obtained later.

In this article it is not purposed to give a general discourse, but to take up the case of one particular girder and show how the general formulas met with in the "pocket books" were applied, the formulas used being accepted as proven. The calculations of the properties of the section used are arranged in the manner followed by the writer, which is similar to that given by Mr. Charles L. Griffen in his article on "System of Engineering Calculations" in the issue of January 12, 1899. The method used for calculating the properties of the section was explained in the issue of December 15, 1898. It will be noted that the inch and pound are used as units, and the bending moment is in inch pounds, which has been found very convenient in practice.

The data for starting these computations were as follows:

Capacity of crane—30,000 pounds.

Span center to center of runway rails—45 feet 8 inches.

Weight of trolley, block and chain—8,000 pounds.

Wheel base of trolley—48 inches.

Therefore, as each wheel of the trolley takes an equal share of the load and weight of the trolley,

$$\text{Trolley wheel load} = \frac{30{,}000 + 8{,}000}{4} = 9{,}500 \text{ pounds.}$$

The following assumptions were made:

Weight of one girder (two required)—5,500 pounds.

Weight of operators' cage, controllers and bridge traverse mechanism—2,400 pounds.

It is required to design a girder able to sustain the following vertical load:

Its own weight (assumed as uniformly distributed)—5,500 pounds.

Bridge mechanism, cage, etc. (assumed as uniformly distributed)—2,400 pounds.

Two wheel loads, each—9,500 pounds.

In addition to the vertical load causing compression in the top chord of the girder, there is a severe lateral pressure caused by the rapid starting and stopping of the bridge travel, to be taken care of by this member.

There are several types of girders in use for cranes, the box or double-webbed plate girder being largely used on account of the simplicity of its construction; at the same time the metal in the top chord, being well distributed to resist lateral strains, makes it a good section for medium spans. For short spans the single-webbed plate girder is an economical shape, and when an auxiliary lattice is added to give it additional lateral stiffness, it is probably the best construction for high-speed cranes. For very long spans and for yard cranes, where wind pressure has to be taken into consideration, lattice girders are used. The section selected for the case in hand is the box type, having the following properties:

A = Area, 32.66 square inches.

I = Moment of inertia, 4351.

Zc = Modulus of section in compression, 330.

Zt = Modulus of section in tension, 279.

R = Radius of gyration of top chord, 4.72.

The calculations for these properties are

shown on calculation sheet No. 1.* At the upper left-hand corner is a rough sketch of the section, immediately below this is an enlarged section reduced to its simplest form. The calculations are carried out toward the right of the sheet at the top, the column of depths containing this dimension for each element of the section in order from top to bottom. The column of widths is arranged in the same manner, and the product for these two dimensions of each element is in the same line in the column of areas. The two numbers, 12.28 and 9.38, at the top of this column are the sum of those elements which constitute the top and bottom chords respectively. The distance from the top edge of the section to its horizontal neutral axis is required next, and is found by calculating the moment of each element about the top of the section. That is, the area of each element is multiplied by the distance from the top of the section to its own neutral axis, the multipliers being found in the fourth column and the moments in the fifth column. The total moment about the top divided by the area of the section gives the distance from the top to the horizontal neutral axis of the section, *i. e.*, 13.175 inches.

The formula for figuring the moment of inertia is:

$$\frac{(h^3 - h_1{}^3)\,b}{3} = I,$$

in which

b = breadth.
h = distance to farthest fibre.
h_1 = distance to nearest fibre.
I = moment of inertia about any axis X—X parallel, as in the sketch, to the neutral axis Y—Y.

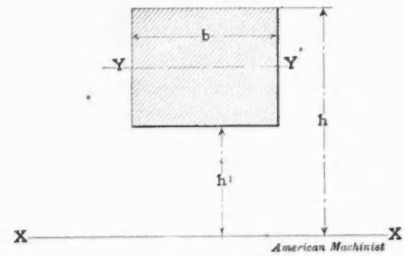
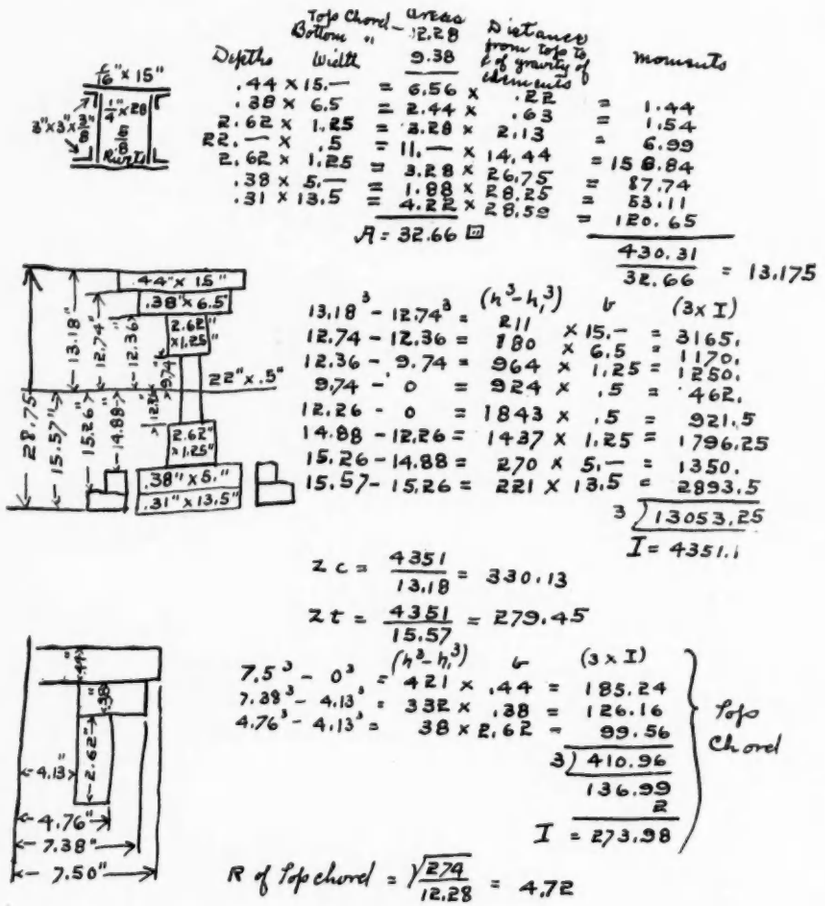


DIAGRAM OF NOTATION.



CALCULATION SHEET I.

The formula is a general one, and either h or h_1 may be negative or positive. This formula, as applied to the section to be used, is found on calculation sheet No. 1, to the right of the simplified section, and the moment of inertia is 4351.

The modulus of the section is found as follows:

$$Z\,c\ (\text{or } Z\,t) = \frac{I}{\text{Distance to extreme fibre in compression (or tension).}}$$

The formula for the radius of gyration is:

$$R = \sqrt{\frac{I}{A}}$$

The top chord or compression member is all that has to be considered in this computation, and its moment of inertia about its vertical axis is calculated by the formula already given.

The load diagram (top of calculation sheet 2) shows a uniformly distributed load and two concentrated ones equally distant from the center of the span. Actually, a good part of the weight of the cage and bridge mechanism is concentrated near one end of the girder, particularly when the bridge motor is placed close to the cage, but for figuring the bending moment it is more convenient to consider it as uniformly distributed. This gives slightly higher results than a more accurate treatment of the case, but being on the safe side and a time saver are good reasons for the short cut. There are two bending moments, one due to the wheel loads and one to the uniform load, the total bending moment being their sum. The formula is:

$$M = \frac{W_1\,l}{8} + W\,a$$

in which

M = Total bending moment.
W = One wheel load in pounds.
W_1 = Uniform load in pounds.
l = Length of span in inches.
a = Distance from point of support to nearest wheel load in inches.

By using this formula the total bending moment of 2,916,150 inch-pounds is obtained, of which 541,150 inch-pounds is due to the uniform load, and 2,375,000 inch-pounds are caused by the wheel load.

The fibre stresses resulting from this bending moment are found by dividing it by the moduli of the section, thus:

$$fc\ (\text{or } ft) = \frac{M}{Zc\ (\text{or } Zt)}$$

in which

fc = fibre stress in compression,
ft = fibre stress in tension,
M = total bending moment,
Zc = modulus of section in compression,
Zt = modulus of section in tension.

In this case fc = 8,837 pounds and ft = 10,452 pounds.

The vertical stresses are next considered; these are at a maximum when the trolley is at the cage end of the girder. The cage is generally placed so as not to interfere with the trolley travel, being suspended from one girder. In most cases a large part of this weight is carried by one web plate. The bridge motor is also bolted to this web plate, sometimes being located just over the operator's head. It is hard to figure out exactly how much of this load is carried by the one web, but, to be on the safe side, it is assumed that five-sixths of it, or 2,000 pounds, comes on one plate, and to this is added one-quarter of the weight of the girder. It is also

*These calculations are explained in detail in the article published in the issue of December 15, 1898, already referred to.

assumed that the entire weight of one wheel load is transmitted to this plate, making a total vertical load of 12,875 pounds. This is probably higher than the actual load, but, except in very heavy cranes, it would hardly pay to go into the matter very deeply. The trolley wheel loads are carried to both web plates, but there is no way to tell whether the division will be equal or not.

The grinder is assumed to be 15 inches deep at the ends, and from this must be deducted the distances from the back of angles to the centers of rivets, 1¾ inches at top and bottom, which leaves a net depth of web of 11.5 inches. The plate being ¼ inch thick, the area in shear is 2.88 square inches, and the shear per square inch is 4,470 pounds. The permissible shear for this case is found by the formula:

$$p = \frac{12{,}000}{1 + \frac{d^2}{1{,}500\, l^2}}$$

in which

p = allowable shear per square inch,

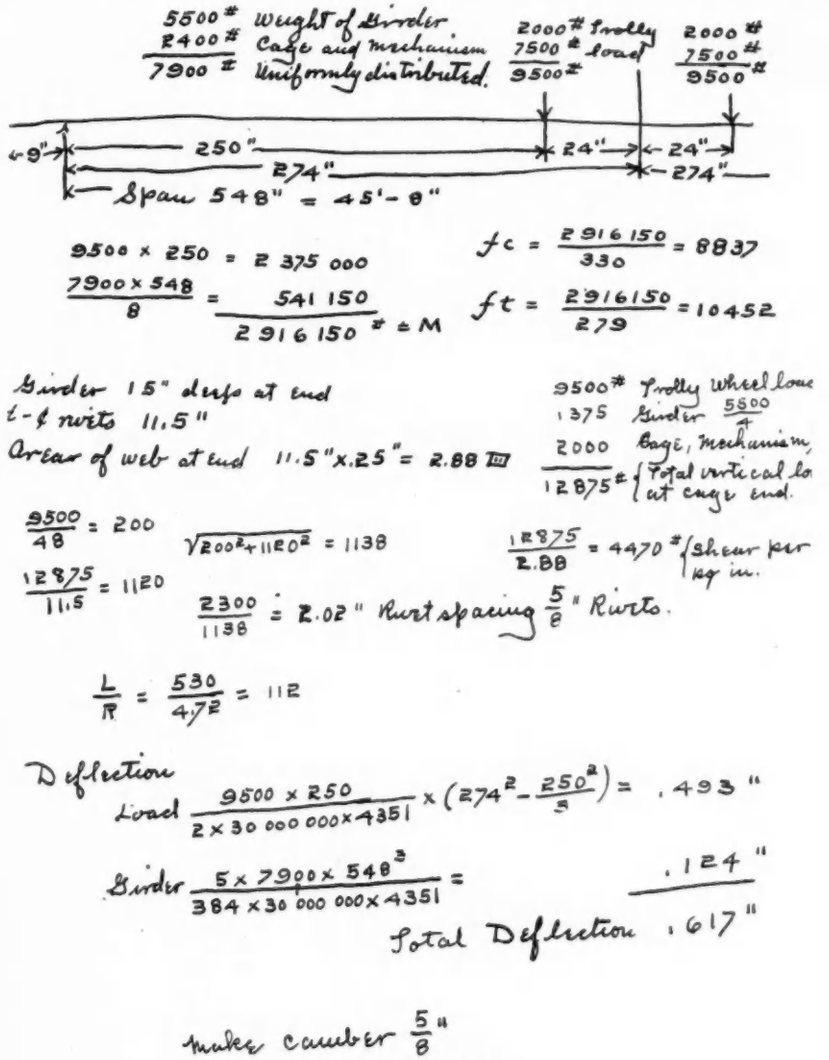
d = depth of web between rivet centers in inches,

t = thickness of web plate in inches.

Substituting the proper values and performing the indicated operations gives:

$$p = \frac{12{,}000}{1 + \frac{11.5^2}{1500 \times .25^2}} = 4958 \text{ pounds.}$$

The stress in the web plate per inch of depth is $\left(\frac{12{,}875}{11.5}\right) = 1{,}120$ pounds. The weight on one trolley wheel is distributed by the rail over a length of 48 inches, which places a stress of 200 pounds per inch of length in the web plate. The resultant of these two stresses at an angle of 45 degrees governs the rivet spacing, and is the diagonal stress in the web plate. This is 1,138 pounds ($\sqrt{200^2 + 1{,}120^2}$) equivalent to 4,552 pounds per square inch. The rivets to be used are ⅝ inch in diameter. In single shear they can carry 2,300 pounds, which, being less than their bearing value in ¼-inch plate, governs the spacing, which is 2.02 inches $\left(\frac{2{,}300}{1{,}138}\right)$. In building the girder the rivets would be put in at about 2-inch pitch at the ends and for a short distance toward the center, then the pitch would be progressively increased until at the center the spaces could be 6 inches long.



CALCULATION SHEET 2.

The top chord of the girder is, in effect, a column, resisting compression, and at the same time, taking the lateral stresses, it acts as a horizontal girder. For this reason it is important that the fibre stresses be low enough to allow an ample factor of safety. In this case the ratio of length to radius of gyration of top chord is 112, the length taken being the unsupported length, in this case 18 inches less than the span. The fibre stress in compression is 8,837 pounds, which is not excessive for the value obtained of $\frac{L}{R}$.

The deflection is found by using two formulas, one for the uniform load and the other for the wheel loads; their sum being the total deflection. The formulas are as follows:

For wheel loads:

$$\frac{W a}{2 E I}\left\{\left(\frac{l}{2}\right)^2 - \frac{a^2}{3}\right\} = \text{deflection.}$$

For uniform load: $\frac{5\, W_1 l^3}{384\, E I} = \text{deflection.}$

in which

W = one wheel load in pounds,

W_1 = uniform load in pounds,

l = length of span in inches,

a = distance from point of support to nearest wheel-load in inches,

I = moment of inertia,

E = modulus of elasticity (taken at 30,000,000 pounds per square inch for convenience).

The total deflection found is .617 inch, which is only 1-878 of the span, showing that the girder has considerable vertical stiffness. When crane girders are cambered (some are not) it is usual to make the camber equal to the deflection, so that the top flange becomes horizontal when the crane is fully loaded.

The stiffener spacing depends entirely on the stiffness of the web. In single plate girders it is usually equal to the depth of the girder. In the double-webbed girder the conditions are entirely different and stiffeners are not as necessary as in the single-web construction. In some cases none is needed, except over the edge of the truck beam where the shear is maximum. Where stiffeners are not used, distance pieces of cast iron, with bolts, are used to tie the webs together. The bolts that fasten the motors, line shaft brackets, etc., should be long enough to pass through both web plates, and separators should be used. In cases where the mechanism, etc., is only bolted to one web plate, angles must be riveted on the inside of the web, and the rivets be countersunk to clear the brackets, although this construction is complicated. Where angle stiffeners are used they are placed inside the girder between the web plates, thus avoiding the use of packing pieces or the crimping of the stiffener to clear the top and bottom angles, and also permitting the pro-

jecting legs of the angles being laced together or a gusset plate being used. In some cases channels can be used for stiffeners with advantage.

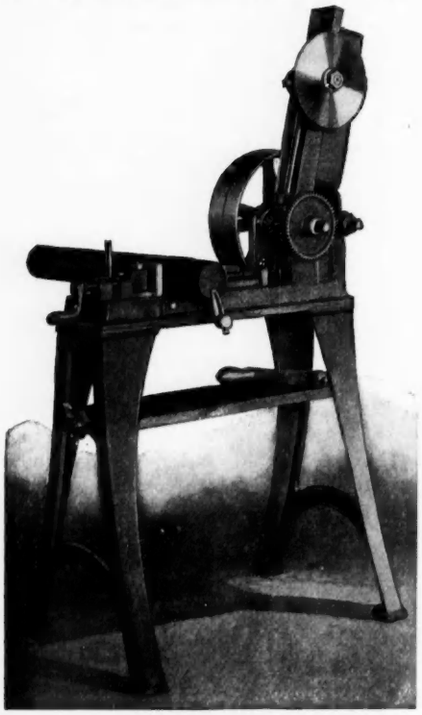
The only calculations in regard to this girder that are not given, are those for its weight, but this can hardly be said to call for any explanation.

As far as these calculations go, they are actual ones for the given conditions, but any change of span, load or trolley would mean something different, unless the change was small, in which case the same section might be utilized.

In getting out detail drawings for this girder, it would be found that each web would be made up of several plates, and the splices would have to be properly proportioned to have uniform strength with the other portions of the girder.

A Cutting-off Saw.

We present herewith an illustration of a cutting-off saw which is intended to compete with the familiar hack-saw machine. In this machine, instead of using a hack-saw with a reciprocating motion, a circular saw is used, which is driven in the manner clearly indicated by the engraving. The machine shown is adapted to be driven either by power or by hand; the latter by means of the crank shown



A NEW CUTTING-OFF SAW.

on the shelf, which crank may be placed on either of the two squared shafts seen at the right; one giving a much faster ratio than the other.

The saws used on the machine are so hard that they must be sharpened by grinding, and a small grinding machine for this purpose accompanies the sawing machine and is part of the outfit.

It is claimed that work cut off in this machine is cut quite square and true, that the saws are very durable, and that the cutting is done rapidly. On the upper side of the swinging arm which carries the saw there is a weight, which is seen in the engraving, behind the saw. This weight has a slot through it, and is held in position by a wing-nut, so that it can be shifted to or from the center upon which the arm swings, and thus the feeding force brought upon the saw readily varied to suit the circumstances. The machine is made by the Marshall & Huschart Machinery Company, 62 Canal street, Chicago.

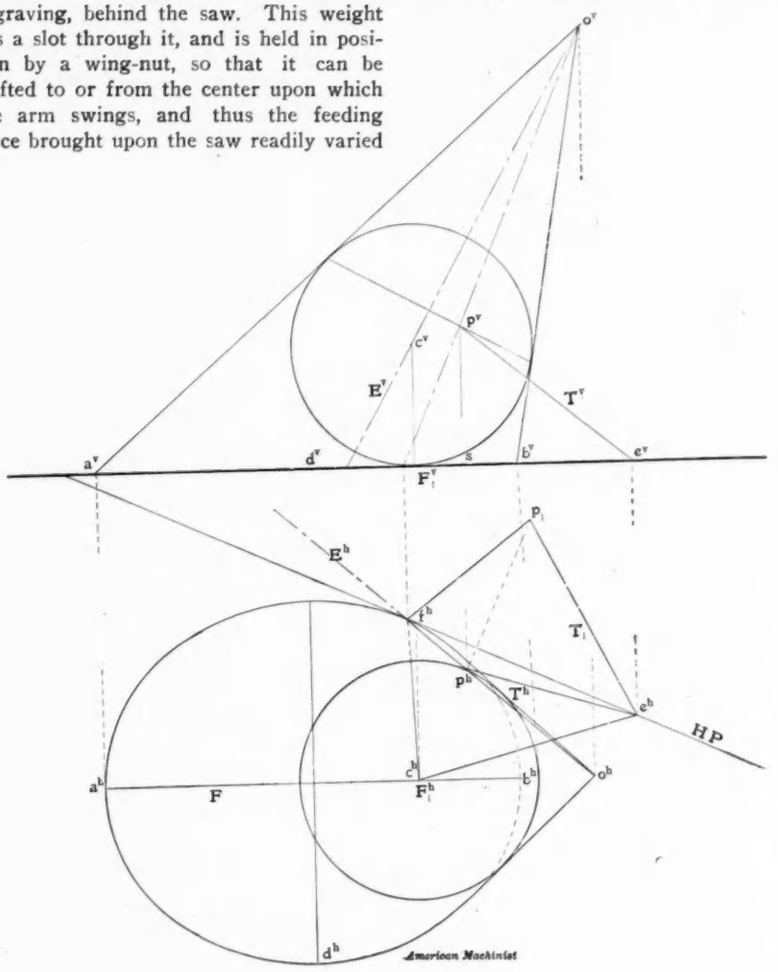


Fig. 1

DEMONSTRATION OF THE METHOD OF CONSTRUCTING LOBED WHEELS.

A New Method of Deriving Holditch's Interchangeable, Elliptical, Lobed Wheels, Together with a Simple Geometrical Demonstration of Their Rolling Properties.

BY H. W. RASCHE.

We are all familiar with the fact that from a cone of revolution an ellipse can be cut. It is also well known that the cone can be developed into a plane surface, and that whatever lines are drawn upon the conical surface before development, will appear in a modified form upon the development.

On the other hand, however, it is, apparently, a fact of recent discovery, that if an ellipse be drawn upon the conical surface and the cone developed, the development of the ellipse will, if centered about the developed apex, turn in perfect "rolling contact" with the ellipse when it is centered about one of its foci; provided, of course, the proper distance intervenes between these centers. And, moreover, if the cone be so chosen that its slant hight bears the proper ratio to the radius of the circular base, a wheel of any number of lobes may be constructed which will roll perfectly with the ellipse or with any other wheel of the set. And when this ratio is as infinity to one, the cone becomes a cylinder and the wheel for this case becomes a rack; that is, a wheel with an infinitely large number of lobes turning about a point infinitely distant. In this connection it may be stated that when the cone becomes a cylinder we know the development of the elliptical section to be a sinusoid, whose maximum ordinate is one side of a right-angled triangle whose hypothenuse and other side are, respectively, the long and short diameters of the ellipse.

The demonstration of these facts is very simple, and for this purpose Fig. 1 is given, in which $a^v o^v b^v$, $o^h d^h a^h f^h$ are respectively the vertical and horizontal projections of a cone of revolution whose

axis is oblique to H and whose base is, therefore, an ellipse. This cone circumscribes a sphere which is tangent to the plane of the elliptical section at the focus F_1.

$H\,P$ is drawn tangent to the base of the cone at f^h; it is therefore the horizontal trace of a plane which is tangent to the cone along the element E. This plane is of course tangent to the inscribed sphere, and $p^v p^h$ are the projections of its point of tangency. c^v and c^h are the projections of the center of the auxiliary sphere.

By means of this figure we seek to demonstrate that the tangent $H\,P$ to the elliptical section $a^h d^h b^h f^h$, at f^h makes the same angle with the element E of the cone as it does with the focal line $f^h F^h$.

To establish this fact is sufficient and necessary, for it is obvious that the second condition of rolling contact is fulfilled, viz., that the pitch lines of the sectors be of equal length.

The condition which we wish to show as obtaining is usually stated as follows: At each point of either pitch line the 'obliquity" must be the same as at corresponding points of the other pitch line. By corresponding points is meant points between which there are equal lengths of pitch line; these lengths being measured along either pitch line from a point which these lines have as a point of tangency. By "angle of obliquity" is meant the angle included between a tangent at any point of a pitch line and the radius vector joining this point to the center of rotation of the sector.

Demonstration: Select some point, as e, on tangent $H\,P$; join the point to F and to p. Then it is evident that the triangle $F\,f\,e$ is equal in every respect to the triangle $p\,f\,e$ (it should be remembered here that p is a point in space distant $p^v\,s$ from H, and that f and e are points in the H plane, taken on $H\,P$); for the side $f\,e$ is common and the remaining homologous sides are respectively equal, being pairs of tangents from the same points without to the sphere whose center is c. The angle $p\,f\,e$ is, therefore, equal to the angle $F_1\,f\,e$; or the tangent to the ellipse at f makes the same angle with the element E through that point as it (the tangent) does with the focal line $F_1\,f$.

Now, since the angle between the tangent $H\,P$ and the element E is not affected by development, it follows that the development will turn about the developed apex as a center in perfect rolling contact with the ellipse.

Of course the condition that the sum of the radii vectores must be constant and equal to the distance between the fixed centers, sometimes stated as necessary that two sectors may turn in perfect rolling contact, is an obvious consequence of the two preceding conditions.

The proof just given is evidently independent of the angle at the apex of the cone, and therefore holds for any cone. Now, mathematically speaking, the cylinder is only a special case of the cone; the demonstration is therefore good for the cylinder. Hence, if a cylinder be cut by a plane oblique to the axis, the resulting ellipse will rotate about either of its foci in true rolling contact with its development, when such development is placed at a fixed distance from the stationary focus and given a motion of rectilinear translation in the direction of its length.

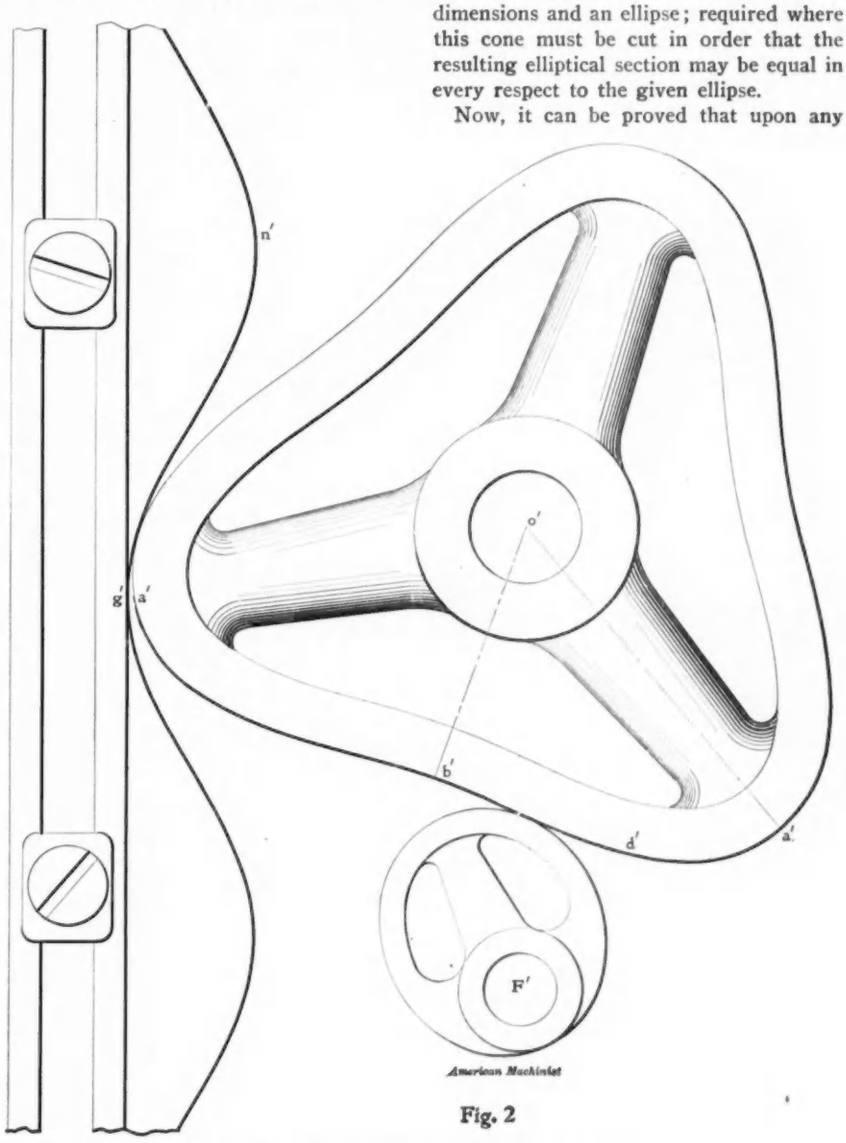


Fig. 2

UNILOBE AND TRILOBE WHEELS AND LOBED RACK.

To derive a wheel of a definite number of lobes to roll with a given ellipse (unilobe), we proceed as follows, calling the number of lobes n: Construct a cone of revolution whose slant hight bears to the radius of a circular section, taken at the extremity of said slant hight, the ratio $\frac{n}{1}$; cut this cone by a plane so that the resulting ellipse will be equal in every respect to the given ellipse (unilobe). The development of this curve will be the nth part of a wheel of n lobes. The remaining lobes are supplied by duplicating this part.

Fig. 3 shows the method of deriving the rack. Fig. 4 shows the construction of a bilobe and a quadrilobe. Fig. 2 shows a unilobe, a trilobe and the rack in proper contact. These need no explanation here, their construction being evident from the figures.

The only question which seems to merit further notice may be stated:

Given a cone of revolution of definite dimensions and an ellipse; required where this cone must be cut in order that the resulting elliptical section may be equal in every respect to the given ellipse.

Now, it can be proved that upon any elliptical base an infinite number of cones of revolution can be constructed the difference between whose maximum and minimum elements (measured from this base) is a constant and equal to the difference between the foci of the ellipse. (This condition is evidently in harmony with the fact that in any system of interchangeable multilobes the difference between the greatest and least radii must be constant.) We shall see how this fact can be utilized. The problem just enunciated can obviously be resolved into one of plane geometry, which, referring to Fig. 1, may be thus stated:

Given one side $a^v b^v$ of a triangle $o^v b^v a^v$, and the difference $F F_1$ between the other two sides and the angle between these sides; required the triangle.

This problem is susceptible of a very happy solution, for which credit is due to Capt. C. E. Vamter, a distinguished Southern educator and mathematician.

Solution: On $a^v b^v$ construct a segment of the circle, one-half of which will measure the given angle. (This is easily done by elementary geometry.) On $a^v b^v$ construct, also, a segment of a circle one-half of which will measure 90° + one-half of the given angle. With the difference $F F_1$ as a radius and a^v as center, sweep an arc cutting the smaller of the two circles, already constructed, in a point which, if joined to a^v and produced, will meet the larger circle in the vertex of the required triangle. This being joined to b^v completes the triangle, and thus determines where the plane must intersect the given cone in order that the resulting curve of intersection may be an ellipse equal in every respect to the one given.

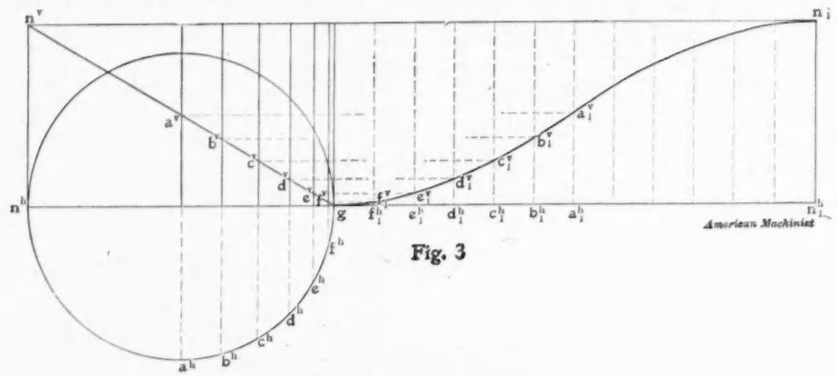


Fig. 3

DERIVING A LOBED RACK.

For example, suppose we are given a cone of revolution whose elements make a definite angle (this angle depending upon the number of lobes in the resulting wheel) with the axis, and that it is required to so situate this cone with respect to the coordinate plane H that the trace of the cone on H may be an ellipse equal in every respect to that one shown in Fig. 3. To do this, we assume, for convenience, the major axis of the given ellipse parallel to the ground line in Fig. 1. This axis is projected on the vertical plane in $a^v b^v$, which is the base of a triangle $o^v a^v b^v$, of which we have given the base $a^v b^v$, the $< a^v o^v b^v$ and the difference $F F_1$ between the lengths of $o^v b^v$ and $o^v a^v$. The triangle is constructed as previously explained, and is the vertical projection of the cone properly located. The construction of the H projection is obvious, and therefore needs no explanation.

A practical abridgment of the above construction will readily suggest itself to one familiar with the elementary principles of

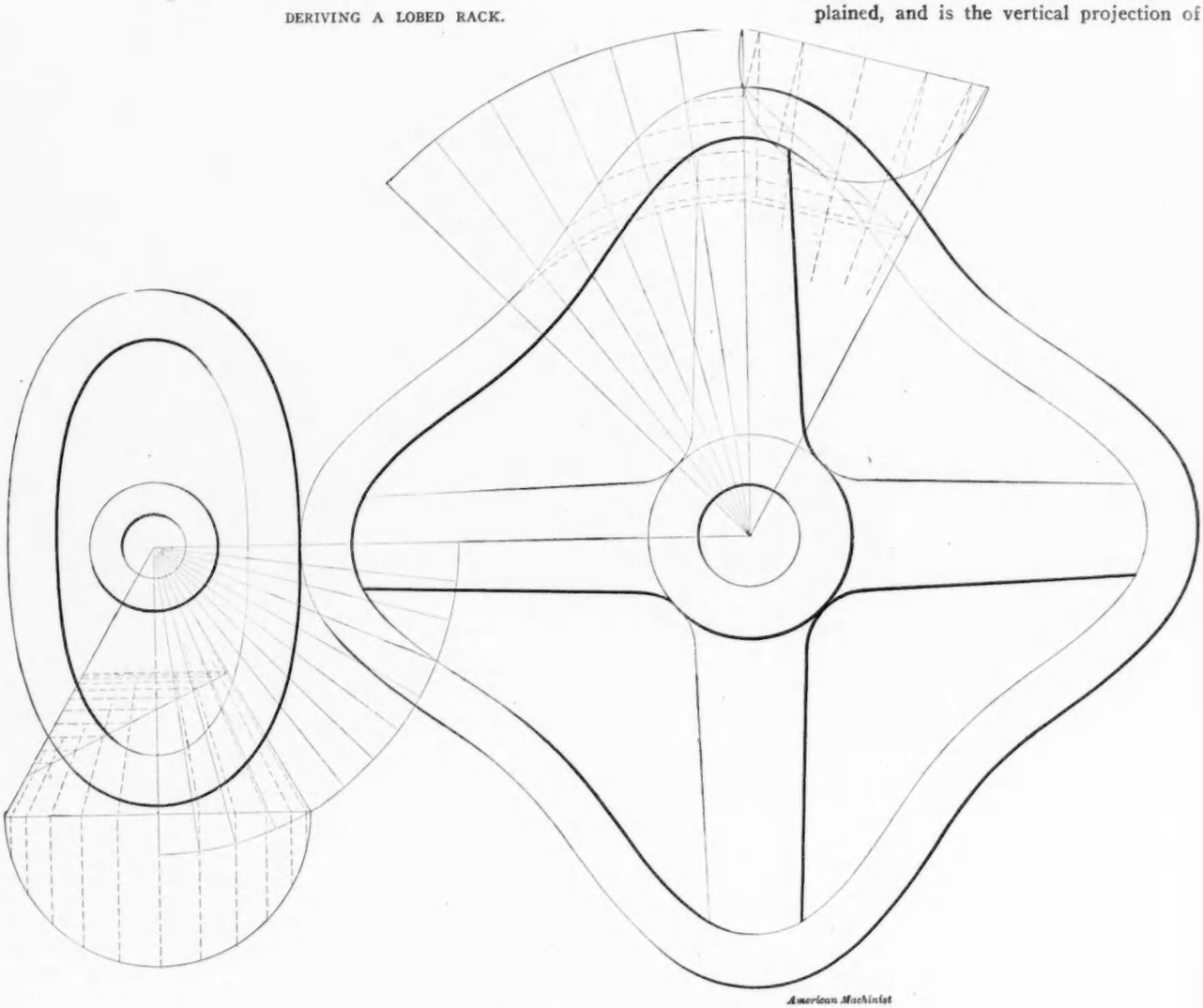


Fig. 4

ACTUAL CONSTRUCTION OF BILOBE AND QUADRILOBE.

descriptive geometry, and is shown in Fig. 4.

In conclusion, the writer wishes to state that he believes this method of deriving these wheels to be due to him.

He presents this paper with the hope that the method herein explained will be found simpler, less laborious, and thus more practical than that devised by his distinguished predecessor, while at the same time affording a more ready proof of the rolling properties of these interesting wheels.

Virginia Polytechnic Institute.

Molding a Flywheel.

BY R. H. PALMER.

Fig. 1 shows the mold partly made, Fig. 2 the mold after pouring and Fig. 3 one-half of the casting. About 18,000 pounds of iron were required for the pouring, the weight of one-half of the casting being 8,560 pounds, as marked.

The only patterns furnished were a segment of the rim, marked *a* in Fig. 1, and the lug standing off to the right with the thin core-print in each end of it. There were core boxes for the arm cores, the web cores, hub cores, splitting cores, and cores for forming the lower flange. This comprised all the special material which the molder had to start with; the product will speak for itself.

A hole is first dug at what is to be the center of the wheel, and the spindle seat *F*, Fig. 4, is bedded in the spindle or upright shaft, being carefully plumbed. A finger, as the molders call it, is then dropped to the position wanted. In the center of the spindle, Fig. 1, is seen the finger, with a hub by which it is secured to the spindle, and to the finger is bolted a board for the sweep. A bed is swept level with the floor line, using the sweep as in Fig. 1, but with the little upright piece left off and the sweep lowered on the spindle to the required level. The sweep is now taken off, and the core which is to form the hub of the wheel below the arm cores is dropped on to its bed, a hole being provided through the center of the shaft core-print to allow it to slide down the spindle. The sweep is next replaced and a guide is put on it for the distance of the inside of the wheel rim from the center. The cores *A*, Fig. 4, which are to form the lower flange inside the wheel rim, are placed in position and spuds, as *B*, are driven at the back. The segment of the rim is now set up, and a piece of board laid on the joint as at *C*, and on this board weights are laid, which keep the segment from ramming out. Facing sand is placed next the segment at *D*, and the sand is rammed in back of core *a* and over it as high as shown in Fig. 1, or, in fact, a very little higher, say about ¼ inch or so, and back to the hub core, the outline of which can be seen at the left of spindle in Fig. 1, but the lug pattern shown standing to the right of the center line is left out. Care is taken to place the cores through which these lugs pass in proper position opposite each other, but the center of the wheel is rammed up all the way around and these lugs are placed in position and bedded, or molded in, after the mold has reached the stage shown. This lug was simply set up to show where it belonged. As the sand is rammed up to the desired hight a gutter is cut, which can be traced by the line of cinders around the mold, and before the segment is moved along, the vent wire is used and vents are run from this gutter toward the inside face *E* of the mold. After being vented this gutter is filled with cinders, as shown in Fig. 1, and the mold is trued off with the strike or sweep to receive the arm cores, some of which can be seen to the right of the spindle. The outside end of the core has a part of the center web formed in it. Fig. 3, looking at the junction of the arm with the rim, will give a better idea of what is formed by this end of the arm core. The web is continued to the next arm by setting two of the web cores shown in the foreground in Fig. 1, while the center

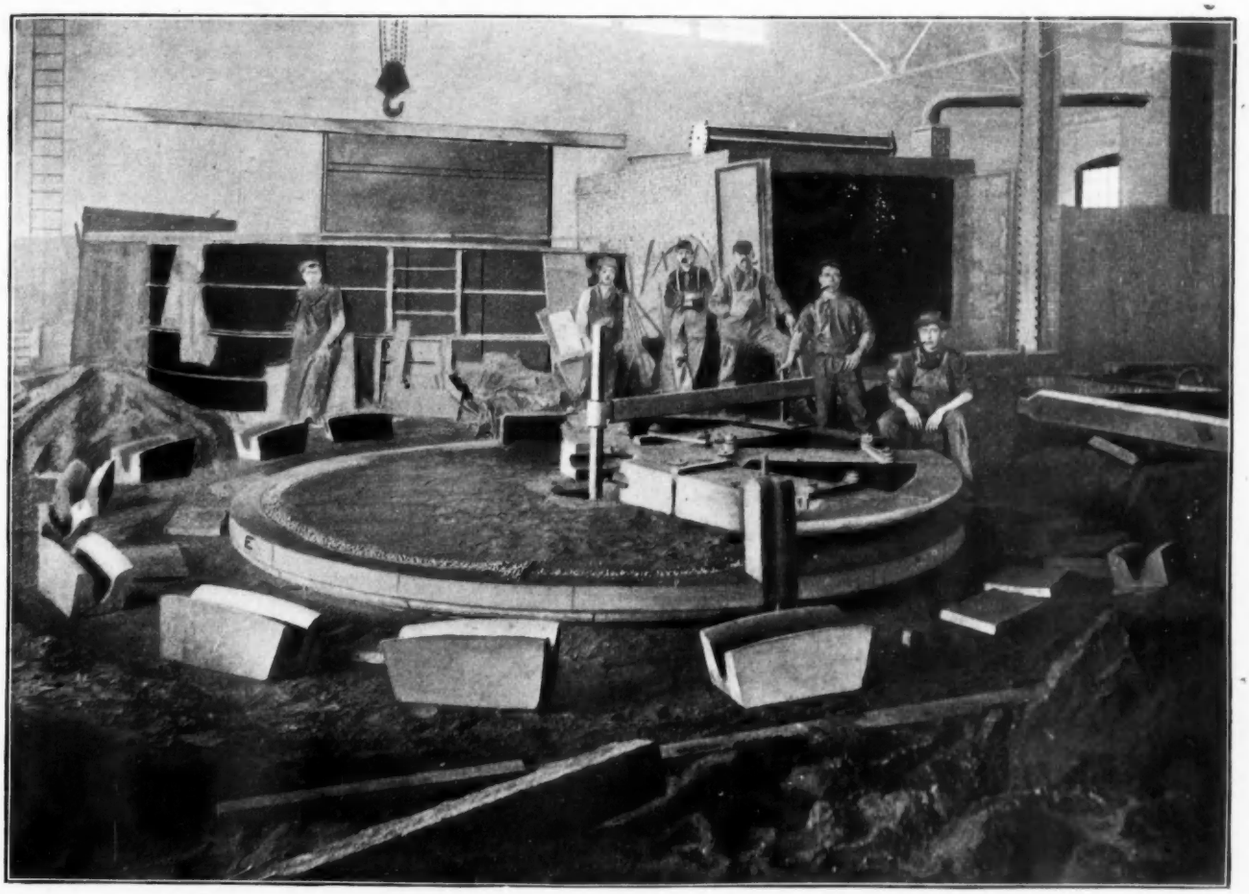


FIG. 1. MAKING THE MOLD.

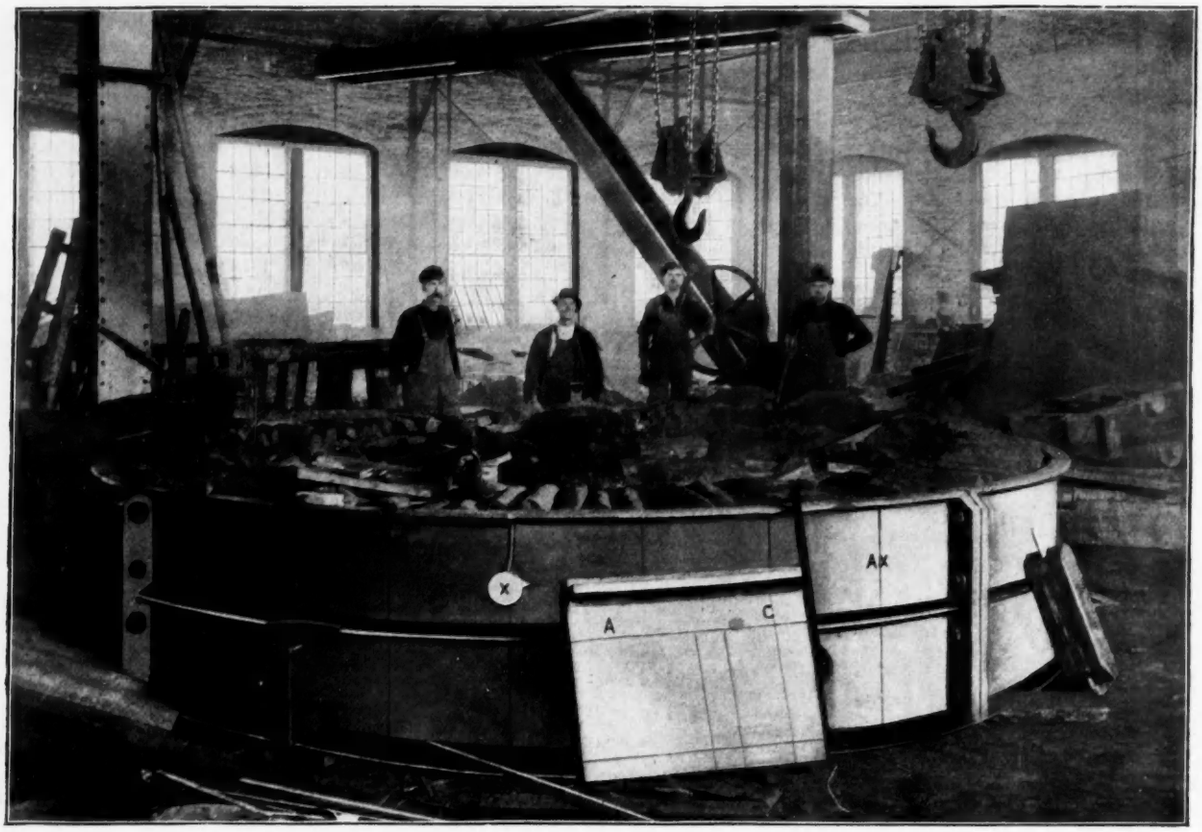


FIG. 2. THE MOLD AFTER POURING.

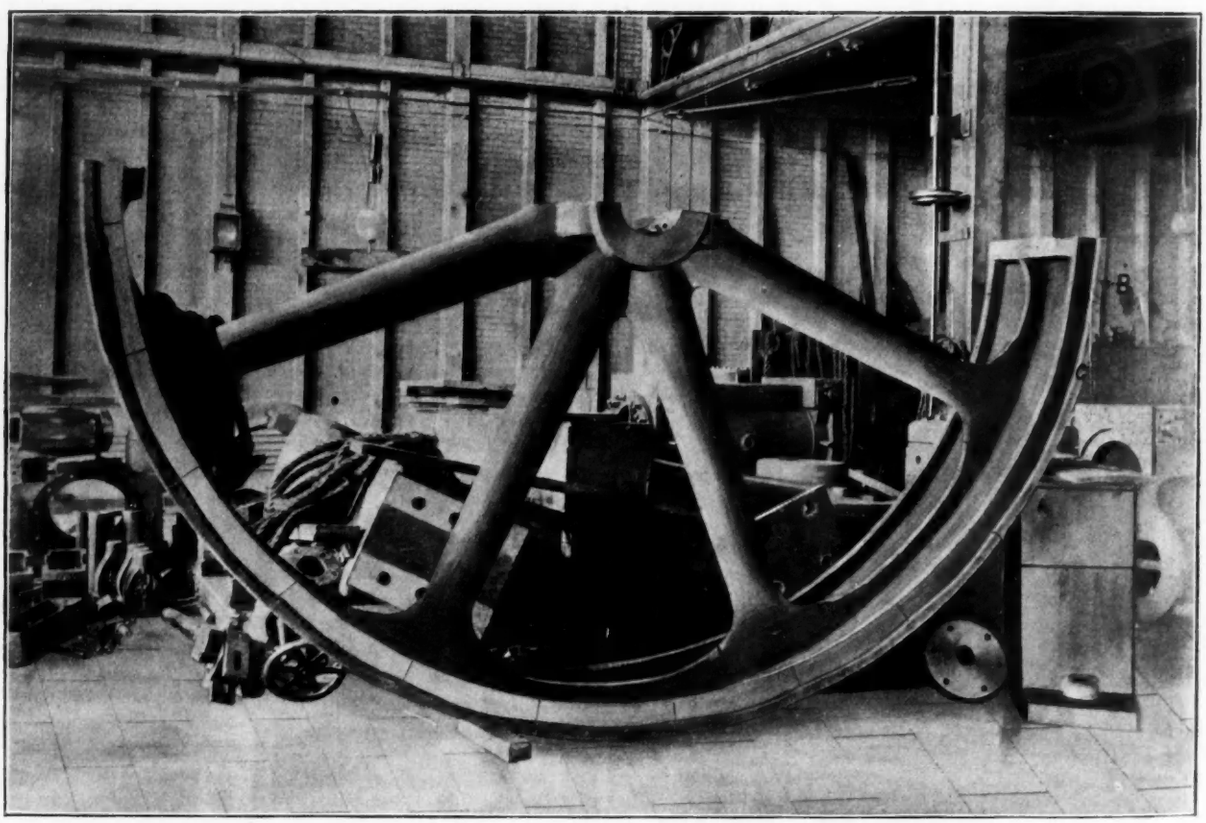


FIG. 3. ONE HALF OF THE CASTING.

lugs, or hub lugs, are formed mostly in the core ends which form the hub of the wheel. In Fig. 3 may be traced how much is formed by each arm core. In setting these cores they must be carefully spaced.

The outside ring or circle forming the flask is seen back of the mold in Fig. 1. It is cast in four pieces and bolted together. If a larger wheel is wanted short segments may be bolted in at the joints. On this ring is seen at *x*, Fig. 2, one of four lugs cast on to handle it by. At *B*, Fig. 2, a stake is driven into the floor to guide and steady it down where it belongs, and bearing against the stake is a lug or angle iron bolted on to the ring. The two, acting in conjunction with the others, are equal to pins and plates on a flask. On the inside of the ring a flange runs all the way around, and at regular intervals there are holes in it. The flange keeps the sand from sliding out when the ring is hoisted off.

Let us return to the mold: We have the arm cores and the center web cores in position, also the lugs. The joint is cleaned off, the sweep has been removed and the segment pattern is now placed in position. Near the top of the pattern is what is to form the top flange *c* in the mold, while above it extends a shrink head or dirt catcher. At the right-hand side of this segment as it leans against the flask in Fig. 2 we see a strip of iron bolted at *a x*. We see this iron has an ear rounding out with a hole through it. There are arrangements made for fastening the arm from the spindle to it by other ears. The arm running from the spindle to the segment is placed handy. The ring is hoisted and dropped around the mold in the required position, and a few blows are given with a sledge on a block held on top of it to settle it to its bearing, and it is staked. The arm from the spindle is connected with the top of the segment. Now we set the gate stick, which is to take the gas from the line of cinders shown in Fig. 1.

In starting this part of the molding be careful to ram evenly on both sides of the segment. On the inside the ramming will naturally have a tendency to force out the center web cores, and when above these cores to spring away the other end of the segment to which the spindle arm is not attached. That is, if rammed unevenly, so when you have rammed your segment up all the way around, the segment will not slide into the mold where started, which it is important that it should.

We will suppose that we have rammed up to the top of the segment and faced it all the way up outside, and under the flange and against the face above the cores on the inside. We then strike it off level with the top on the outside and level with the top of the flange *c* on the inside. The outside is then one inch higher than the inside. A channelway is cut on the inside a few inches from the inside of the flange, and the mold is vented down between the cores and next to the face above the cores under the top flange, the vents all starting from the channelway. The channelway is then filled with cinders, and it would look like the line of cinders showing in Fig. 1. I should have said that when starting to ram up the segment a board is stood up at each end of the segment and so held that the sand will not work out while ramming up this first one; after this first one is rammed up the board will be needed at only one end. A row of vents is run down on the outside next to the face of the wheel. A short chain is now toggled on to the segment at *a x*, and a bar is dropped through it and into one of the holes in the flange of the flask previously mentioned, and the segment is drawn along and rammed up again, and so on around the circle.

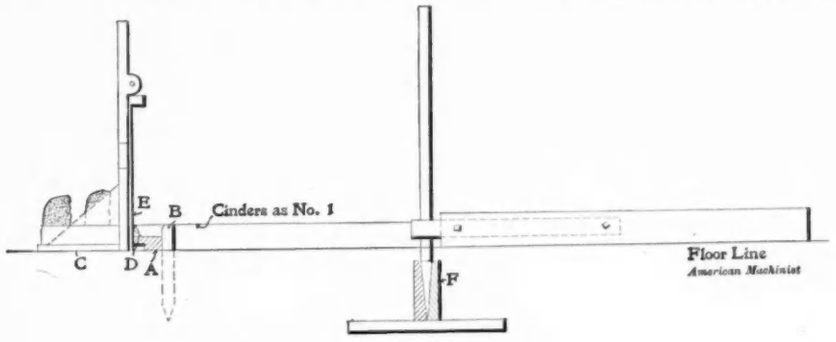


Fig. 4

BEGINNING THE MOLD.

The center core and the split cores in the hub are set. One half of the top hub core is now set in position. This core forming the hub above the arms is the same as the one forming the hub below the arms, except that in this case it is split across and the center is open above the print, and it has the two pouring gates, one in each half.

The second half is then set and pushed up to it, waste or clay being used around the core to stop any cracks; the gate sticks are put in, the vent from the center core is taken care of, and the sand is rammed in around it. A shallow cope is then rammed on top of it.

The segment is now drawn out and the crane is brought over the mold and the ring is hoisted off. The center of the wheel is finished and blacked and chills used for splitting the rim lugs are placed in position. The inside of the ring is finished and blacked and vents are scratched. It is hoisted and brought over the mold and lowered to its proper bearing, being guided by the stakes. Covering cores are now laid over the rim. When the ring was rammed up it was rammed to the top of the segment and struck off, while the inside was rammed to the top of the flange only. This brought the outside 1 inch higher than the inside. The covering cores are made to meet this, as, for instance, one side, the inner, is 2¼ inches thick and extends over the flange that thickness to where the face commences, and it is then made, say, 1¼ inches, so in this way it leaves a thickness the same as the actual rim of the wheel extending above the flange, as shown in Fig. 3. After these covering cores are put on they are weighted with pig iron, and as the covering core also extends over on to the sand rammed up against the ring, and as this sand is on the flange attached to the ring inside, it also helps to hold down the ring. The runner is built extending from over the center, with the gates extending down into the mold (from which the gate sticks are withdrawn) and running to the outer edge of the mold. The iron runner being broken up after pouring while hot, the sand runner can be traced in Fig. 2 by the heap of sand on the top of the mold. Sand is also rammed around inside the covering cores, and gate sticks set in a number of places on top of the cinders in the gutter or channelway. After ramming up the sand they are removed. We thus have a free opening for vent to escape from, this gutter or channelway taking the vent from the upper part and between the cores; the gate stick being removed connecting the lower row of cinders, shown in Fig. 1, there is a free vent all around.

Weights are placed on the runner box and on the shallow cope at the center to hold the center down while pouring, as there is quite a head and the upward pressure means considerable.

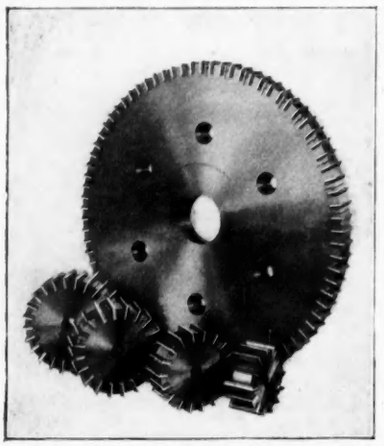
The arm cores can be seen bolted together in Fig. 1, and it shows very clearly how it is done. The wheel was molded by the molder at the right in Fig. 1.

I am indebted to the Colvin Foundry Company for permission to take photos 1 and 2, where the wheel was made, and to the W. A. Harris Steam Engine Company for photo No. 3, where the wheel was delivered, both of Providence, R. I.

An American engineer handling machinery in London writes us that in order to find additional space he was obliged to build an office overhead, and that in doing this he accepted the offer of a Philadelphia concern to furnish the office complete, of oak, varnished and ready to put up, at one-quarter the lowest London offer.

A Collection of Inserted Tooth Milling Cutters.

The accompanying half-tone illustration gives an excellent idea of the sizes to which inserted tooth milling cutters of high-grade construction are now being made, the largest one shown being of



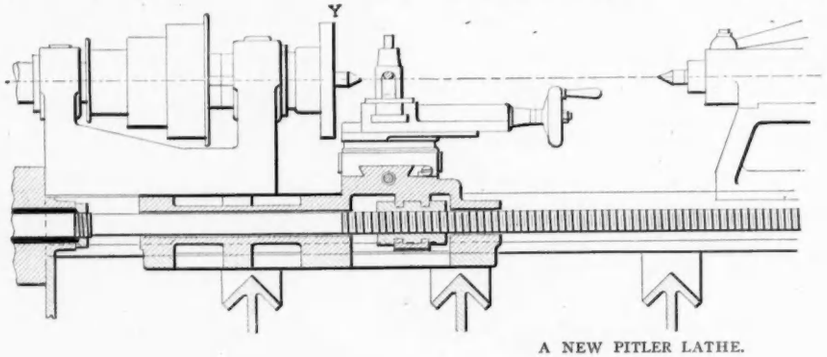
A COLLECTION OF INSERTED TOOTH MILLING CUTTERS.

greater diameter than has before come to our notice.

The cutters were made by the Pratt & Whitney Company, and in all cases will be seen to have the teeth held in place by the favorite construction of these works, a deep saw cut being made between each pair of teeth, with a reamed taper hole at the middle of its depth, into which a taper pin is driven. The diameters of the cutters shown are, respectively, 4, 6, 7, 8 and 27 inches.

An Improved Pitler Lathe.

Wilhelm Von Pitler, the inventor of the Pitler universal lathe, which was illustrated and described by us some years ago, has recently patented a form of lathe bed and carriage which are shown in the accompanying illustration, where, as will be seen, the main bearing surfaces are inside the bed at *A* and *B*. The carriage is quite long and covers these bearing surfaces in such a manner as to prevent chips or dirt from falling upon them, the forward projecting portion of the carriage being adapted to pass underneath the headstock, as shown in the longitudinal section.



A NEW PITLER LATHE.

A New Lathe and Planer Tool.

The sketches, Figs. 1 and 2, will serve to show the essential features of a new lathe and planer tool possessing features of novelty and interest. It is so simple that no elaborate description or illustration is required. Referring to Fig. 1, *A* is the body or stock of the tool as used in the lathe. This is of low carbon steel and of a size suitable for the tool-post, and it is held by the screw of the tool-post in the usual way, or it may be clamped by the two straps and the four studs and nuts that our English friends still insist upon. A hole is drilled in the front end of this piece, just below the upper corner and obliquely backward and downward, until it comes out on the lower edge, and in this is inserted a nicely fitting piece of round Mushet or other steel for a cutter. The top of this cutter is flatted back a sufficient distance, and the sides are ground to give the desired shape to the cutting point. The cutter can then be moved in or out and turned to give it the best cutting angle, or to make it cut in either direction, and it is then fastened by driving the round cross-pin. This pin is straight, and the hole into which it goes is straight, but the pin is flatted on one side, the flat being taper lengthwise of the pin, and this taper flat surface coming against the round surface of the cutter holds it securely. The pin is hardened to prevent wear, and it is a simple job to renew it if necessary. Precisely the same tool may be used in the planer, except that the cutting point would then be ground with less back clearance.

Fig. 2 shows the application of this tool for boring. The boring bar is of the same grade of steel as before, and the cutter is also of Mushet steel. The bar may be of as large diameter as the hole to be bored will permit, up to the width of the slot in the tool-post, and in clamping the bar it will be set to the length required by the depth of the hole. The clamping blocks, it will be noticed, are not of the same vertical thickness, so that by changing places with them the hight of the tool is changed. One end of the bar is drilled for the cutter obliquely, as in the upper figure, which enables the cutting point to work up into a corner, while in the other end of the bar the hole is drilled at right angles for ordinary boring, as in the lower figure. The cutting points in either tool may of course be ground to different shapes as required. It makes a very satisfactory thread-cutting tool for either inside or outside threads. The tools are made in a number of standard sizes, or to special dimensions as required, by Doolittle & Graham, Meriden, Conn.

Device for Putting on Belts.

The sketch shows a recently patented device for running on belts. It is the invention of a German, and as the patent is assigned to Fried. Krupp, of Essen, we may suppose that it is in use at the Krupp establishment. It seems to embody an idea which may be of service in some places. We are all familiar enough with the hook or stud on the end of the pole as commonly used, and of the pull that is usually required and often ineffectual for carrying the belt around the pulley after it is started. The present device provides means for the belt to do its own pulling.

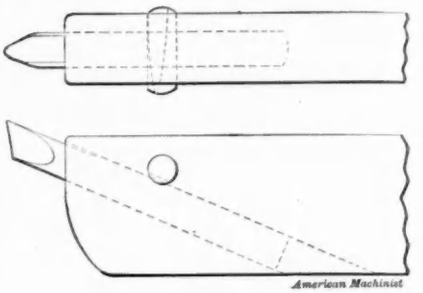


Fig. 1

A NEW LATHE OR PLANER TOOL.

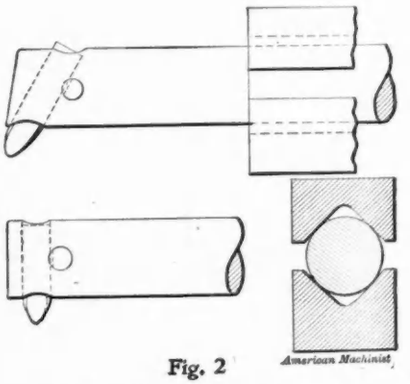
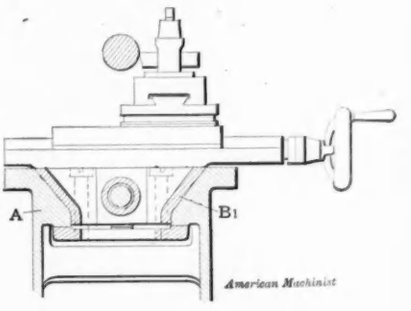


Fig. 2

A NEW ADJUSTABLE BORING TOOL.



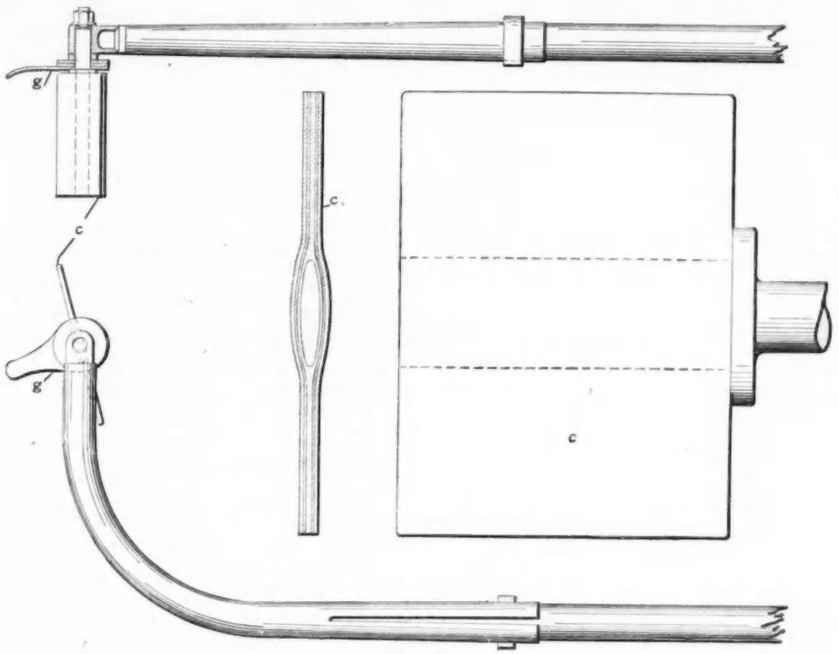


Fig. 1

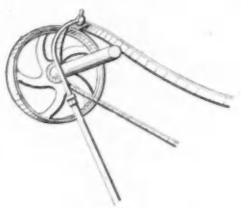


Fig. 2

Fig. 3

A DEVICE FOR PUTTING ON BELTS.

On the end of a pole of sufficient length is fastened a curved arm, presumably of malleable iron, with a hub in which turns freely a pin or stud having a long projection at one side of the pole. On the projecting part of the stud is fastened a flat, flexible piece *c*, having a width nearly equal to that of the belt and its pulley. On the same stud, and at right angles to the normal plane of the flexible piece *c* is the arm *g*. The device is used as shown in Figs. 2 and 3. The flat part *c* comes between the pulley and the belt surfaces, and the arm *g* against the edge of the belt. The pressure of the belt causes a seizure of the flap *c* between it and the pulley surface, and they are thus all carried around together until the belt is on and the flap *c* is brought around to where it is released.

Semi-Automatic Screw Slotting Machine.

The accompanying illustrations show a screw slotting machine which is in use at the works of the Acme Machine Screw Company, of Hartford, Conn. It was designed for use in slotting headless screws and similar work, to which the ordinary revolving hopper and elevating fork do not apply.

Fig. 1 shows the machine from the operator's side. At *a* and *b* are two screw carrying disks, drilled on the opposing surfaces with half holes of such diameter that when the screws are inserted the disks, when squeezed together, will grip them.

The left-hand disk is driven by a worm

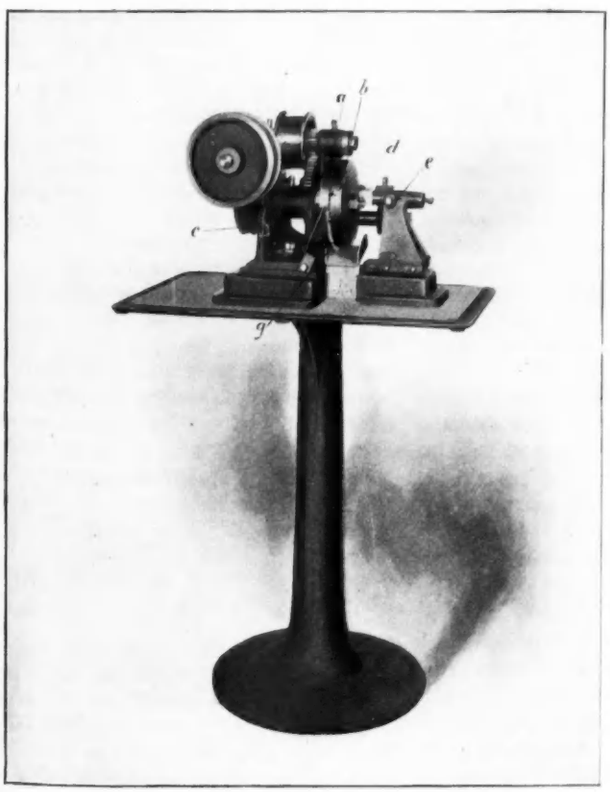


FIG. 1. SCREW SLOTTING MACHINE. OPERATOR'S SIDE.

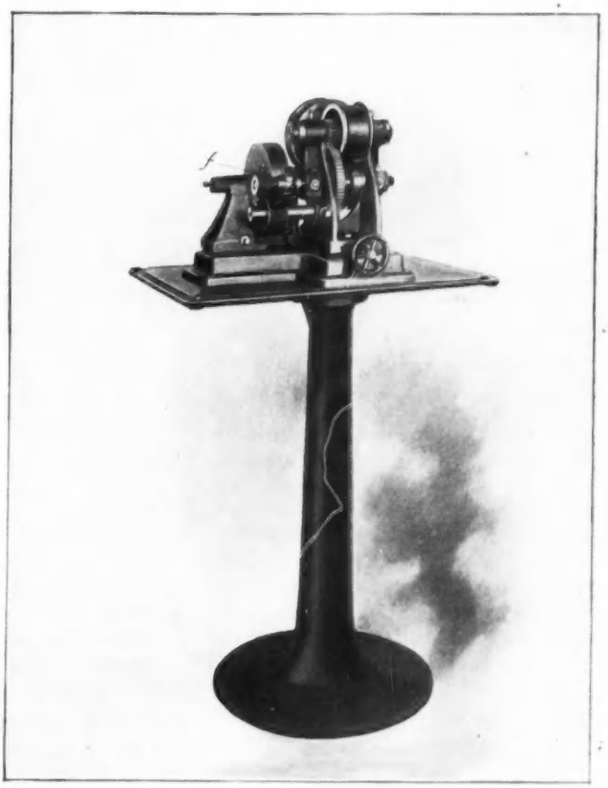


FIG. 2. SCREW SLOTTING MACHINE. REAR SIDE.

at *c*, and the right-hand one has its bearing slightly rounded so as to permit a rocking motion. The screws are inserted at *d*, at which point the disks are sufficiently parted to permit this being done. As the disks revolve they are closed by a bunter *e*, which is directly opposite the saw *f*, as shown in Fig. 2, and which thus holds the screw tight while passing the saw. After passing the saw the disks open again, and the screws drop out, being assisted by the extractor *g*.

Under favorable conditions the capacity of the machine is said to be as high as 25,000 screws per day.

Gas Engine Guarantees Technically Considered.*

BY WILLIAM T. MAGRUDER, M. E.

Under this title may be considered such guarantees as power ratings, regulation, cost of running and fuel consumption.

Under the first of these it may be said that quite a number of gas engine catalogs fail to recognize that there is a decided difference between the nominal, the indicated and the actual horse-powers. As from 10 per cent. to 35 per cent. of the work done by the piston is used up in the friction of the engine itself, only the balance, or from 65 per cent. to 90 per cent. of the total indicated work, reaches the crank shaft and is delivered by the belt pulley, and is the actual horse-power of the engine. As it is a simple and easy matter for a competent engineer to measure the actual horse-power of the engine by means of an absorption dynamometer or brake, and as the purchaser is chiefly concerned with the amount of power which is actually delivered to him by the engine, it seems both reasonable and proper that engines should invariably be sold and guaranteed by the actual horse-power which they will deliver at the belt pulley or crank shaft, irrespective of any other considerations. This should be the case especially in view of the fact that it is practically impossible to measure accurately with the usual gas engine indicator the indicated horse-power of an engine having either a throttle or a hit-and-miss governor and a load which varies. If the load be constant and the engine can be so adjusted that the indicator cards obtained are practically of the same area, the difficulty is removed; but with many engines having either hit-and-miss or throttling governors the variation in the indicator cards is such as to preclude an accuracy greater than 90 per cent. to 95 per cent. The indicator is of inestimable value, and in proper and careful hands without doubt tells the truth; but the usual gas engine indicator tells the truth for only the one double revolution for which a card is taken, and gives no indication of the amount of work which is being done while the card is being removed from the paper drum and another one put in its place. The best that we therefore can do is to strike an average of the mean effective pressures of as many indicator cards as it is possible to accurately take in a given time, and from this average mean effective pressure determine the average horse-power for the time so taken. The chief value of the indicator will be found to be in the indications that it gives of the faulty setting of valves and of excessive back pressures. Many other uses of the indicator, with which you are all doubtless familiar, could be cited so as to show its great utility, both in the testing room and with the engine on its permanent foundation; but the accurate measurement of power under varying conditions is not, in the opinion of the writer, one of these uses.

The fact that many gas engine builders have not yet loosed themselves from the tethering strings of the steam engine is evidenced by the frequent allusions and comparisons to that inefficient but very useful machine. It is a fact which numerous tests have proved that there are on the market to-day steam engines whose guaranteed and obtained regulation is within 1 per cent. from no load to full load and back to no load. These engines may be directly connected to the armature shaft of the generator by rigid couplings. To say, therefore, that a gas engine regulates as closely as a steam engine should mean that it regulates to within 1 per cent. There doubtless are some steam engines which do not regulate any more closely than do some gas engines, but the writer has never seen any steam engine which regulated as badly as some gas engines which he has seen. With extremely heavy flywheels on not only the engine, but on the jack shaft and also on the armature shaft, regulation can be obtained which doubtless will be within two volts; but the question still arises whether it is advisable to pay in extra journal friction this very high price in order to obtain this increase in regulation. In some cases which have been reported, this extra journal friction has amounted to from 10 per cent. to 15 per cent. When a manufacturer finds himself caught in a contract in which he has agreed to furnish power with a definite regulation of speed, there is little left for him to do but to adopt the principle of kinetic energy as worked out in the flywheel.

The cost of running a hydrocarbon engine is a direct function of the physical properties and cost of the fuel used. When a hydrocarbon engine was of necessity a gas engine using coal gas, there was no indefiniteness in the subject, but when city gas plants replaced their coal gas apparatus by appliances for manufacturing water gas or some other form of enriched vapor, the cost of the gas was decreased and likewise sometimes the cost of running the engine. When it was found that not only so-called gasoline, but kerosene, petroleum oils and petroleum residue could be used in the generation of power by the gasification of one or other of these liquids, the problem of hydrocarbon engine economics took on a much more complex form. It is absolutely essential that the engine manufacturer of to-day, in making guarantees as to the cost of running, should not only know the cost per cubic foot or per gallon of the fuel which is proposed to be used, but the calorific value of that fuel per cubic foot, per pound or per gallon, under known conditions, and also the other physical properties of the fuel. Employees of the Standard Oil Company have stated to the writer that their company are unwilling to guarantee the so-called 74° B. gasoline, but simply sell it as "stove gasoline," and of a variable specific gravity. According to the strict use of the word, gasoline is a petroleum ether whose specific gravity is between .629 and .667, corresponding to the gravity of from 95° to 80° B., and that the so-called 74° stove gasoline is a petroleum spirit, and is what is known as C. Benzine Naphtha, having a specific gravity of .686. Gasoline engine manufacturers should, therefore, be extremely careful how they guarantee the cost and the fuel consumption of such a variable and volatile substance as benzine, naphtha or stove gasoline, and should remember that the gasoline ether has a still lower temperature of evaporation.

The most difficult subject to treat completely and yet in but few words has been reserved for the last, and is the more difficult because the more technical. A fuel is sometimes defined to be that substance which, by combustion with the oxygen of the air, can be used for the economical generation of heat. Under this head, therefore, may be included the various artificial illuminating gases, natural gases, water gases, producer gases and the various liquids obtained either directly or by distillation from petroleum products. As these vary so greatly in their specific gravities, physical characteristics and calorific values, it is manifestly impossible that any engine can be designed which shall be equally efficiently "adapted to either illuminating, natural or producer gas, without any change whatever." By the calorific value of a fuel is meant the number of British thermal units which a cubic foot or a pound of that fuel, at a known temperature and pressure, will produce when completely burned in an adequate supply of oxygen. Referring to tables as usually found in books, it will be seen, for example, that Pittsburgh (Pa.) natural gas has 495 heat units per cubic foot, while natural gas from the Burns well in Butler County, Pa., has 1,151 heat units per cubic foot; that water producer gas has 104; that American water gas has 185; that 15-candle-power illuminating gas has 620; that gasoline vapor has 690 heat units per

* Abstract of a paper read before the National Association of Gas and Gasoline Engine Manufacturers.

cubic foot, or 11,000 per pound of gasoline. This being the case, it is evident that a cubic foot of Pittsburgh natural gas, having 495 heat units, will not require as much air per cubic foot as a cubic foot of Butler County gas, having two and one-third times as many heat units, and in consequence will not give off as much heat or produce as much power; hence it should not be expected that a 10 horse-power engine using Butler County gas will give 10 horse-power when using Pittsburgh gas. Again, as the heat units in a cubic foot of gasoline vapor and in a cubic foot of 16-candle-power illuminating gas are said to be practically the same, the power obtained from a gasoline engine using the gasoline vapor should be practically the same as the power obtained from a gas engine using the 16-candle-power illuminating gas; but it does not necessarily follow that the ratio of air to gas should be the same, as the chemical constituents of the two fuels are different. Neither does it follow that duplicate engines using these two fuels will give the same amounts of horse-power without any change whatsoever. The practical point, then, for your consideration is this: In guaranteeing fuel consumption, not only must it be known what the fuel is that it is proposed to use, but also the calorific value of that fuel and the best proportion of air with which to supply it. As an illustration of this, one catalog guarantees to deliver an indicated horse-power on 17 cubic feet of coal gas or 15 cubic feet of natural gas. If the natural gas has 1,000 British thermal units, the coal gas would have to have 882 thermal units, if equally efficiently consumed, to produce the same power. This would mean that it would have to be 24-candle-power coal gas; or, if the coal gas had only 700 British thermal units, then a natural gas having 793 would be in the same proportion. Again, as it is essential that there should be fuel in order to generate heat, so is it exactly equally essential that there should be an adequate supply of oxygen, which means air, in order that this heat shall be generated. When we say that we burn 20 cubic feet of gas per horse-power per hour, we might with equal correctness say that we burn 120 cubic feet of air per horse-power per hour, as that is exactly what we do. Hence, as a gas of a high calorific value usually requires more air than does one of low calorific vaiue, it is absolutely essential that the air valves, passages and pipes which supply air to the engine should be of the proper size. This is a point which cannot be emphasized too strongly, for the reason that in the experience of the writer both gas and gasoline engines could be greatly improved by the enlargement of the air inlet. In one case an engine greatly exceeded its guaranteed horse-power when air was fed to it by means of a blower. In another case, it was apparently intended by the builders that the air should be sucked in through a pipe from the base through cracks between the base and the foundation—a manifest absurdity. In another case, a 20 horse-power engine, which gave but 19 horse-power, gave 22 when the air pipe and several elbows were removed so as to allow the air to get to the air inlet valve directly and without excessive friction. This is equally true of the gas supply pipes. It is the writer's practice to advocate pipes at least one size larger than the gas inlet valve, as he finds that more power can be obtained by allowing the engine to take a full supply of gas at as great a pressure as possible whenever its governor so elects, rather than to throttle the pressure and decrease the quantity of gas in a charge. As the volumes of gases increase with temperature and decrease with pressure, the colder the gas and the higher the pressure the less will be the number of cubic feet of gas at that temperature and pressure which will be used per horse-power per hour. In one case which came under the writer's observation a 75 horse-power engine is said to have run for a month, using less than 10 cubic feet of natural gas per horse-power per hour. When the writer heard of it, instead of congratulating the owners, he inquired why they had used so much. Upon inquiry it was stated that the average temperature of the gas for the month was about 20° Fahr., and that the average gas pressure was 18 pounds per square inch. If the gas had been supplied at atmospheric pressure or even at one-half pound pressure and at 60° Fahr., there would have been required about 23½ cubic feet of it to weigh as much as 10 cubic feet of the same gas when under 18 pounds pressure and at 20° Fahr. Another illustration of the application of the same principle under similar but opposite conditions to the above can be cited in the case of an engine using city gas at 10 to 20 tenths of water pressure and at 60° Fahr. when in the mains. When the engine is first started, the gas pipe, cock, gas inlet valve, mixing chamber, etc., are comparatively cool; but after an hour's running, especially at full power, they all become warmed up and get quite hot, and as a result the temperature of the gas is increased, we will say, to 260° Fahr., for a figure, or an increase of 200° Fahr. while passing from the gas bag to the interior of the cylinder and before the gas inlet valve closes. Now let us consider what this means. The gas was at 60° Fahr., which is 460 + 60, or 520° above the absolute zero of temperature on the Fahrenheit scale. Now it is at 260° Fahr., or 460 + 260, or 720° Fahr. on the absolute scale of temperature. As the volumes of gases are directly proportional to their absolute temperatures, 1 cubic foot of gas at 60° Fahr., or 520° Fahr. absolute, will occupy $1 \times \frac{720}{520}$, or $1\frac{5}{13}$ cubic feet when heated to 260° Fahr., or 720° absolute. Or, to reverse the proposition, as the temperature of the gas is increased 200° Fahr., 1 cubic foot of cylinder gas volume will be completely filled by 13-18 or .72 cubic foot of gas as measured by the meter. The same proportions and reasonings hold in the case of the air supply. This is one of the reasons why many hydrocarbon engines let down and do not give the same horse-power on the last hour of the test when working at full load that they did on the first hour. The above is but an illustration of the application of Gay-Lussac, or Charles, law of physics to an everyday gas engineering problem.

One more illustration must suffice to illustrate the application of the Boyle, or Mariotte, law of gases to the same problem. Let us assume that we have both gas and air delivered to us at 60° Fahr., so that the question of temperature does not enter, but that, owing to our altitude above the sea, the pressure of the atmosphere is only 10 pounds per square inch, instead of, say, 15 pounds. That means that to get enough oxygen to consume with our fuel, instead of using 6 cubic feet of air per cubic foot of gas, we must supply $6 \times \frac{15}{10}$, or 9 cubic feet, and that means that our air inlet pipes and valves and our cylinder must be just that much larger.

The practical conclusion then from these illustrations is that, for the best results, the gas and air inlet connections and valves should be kept as cool as is practicable and should be properly and correctly proportioned for the fuel and air which they are going to use. Hence, in making engine guarantees as to power ratings and fuel consumption, it is essential that both the pressure of the air and the character and quality of the fuel that is to be used, its calorific value and specific gravity, its pressure and temperature, should be definitely and completely specified.

The writer has suggested the guaranteeing of a horse-power on a given number of heat units with a given fuel. There will then be no guessing, as a horse-pow r is 33,000 foot-pounds of work per minute, and as there are 778 foot-pounds in a British thermal unit, it would mean that $\frac{33000 \times 60}{778}$, or 2,545 B. T. U. would be required per hour for the generation with perfect efficiency of one indicated horse-power. Then, if the thermodynamic efficiency, or its efficiency as a heat engine, was 25 per cent., it would require 10,180 B. T. U. per indicated horse-power, and if the friction, etc., of the engine was 15 per cent., then 11,976 B. T. U. would be required per actual horse-power. This is the practice in many lines of steam and electrical engineering to-day, and it is suggested as a suitable method of guaranteeing gas-engine performances.

The day has gone by in the history of gas-engine manufacture when gas-engine guarantees can be made and accepted and paid for on "so many feet of gas per horse-power," and nothing more.

Letters from Practical Men

The Swelling of Cores.

Editor American Machinist:

I had occasion the other day to have an argument on the swelling of cores for a cast-iron casting. Fig. 3 is a casting, and Figs. 1 and 2 show the core. The main core is about 4 feet long and 7 inches diameter, while the branches are 14 inches long and 5 inches diameter, the entire core being made in a single piece. Should or should not the core be made with the same shrink as the pattern? Supposing the distance *A* on the pattern was made ⅛ inch shrink to the foot, should the same allowance on the corebox be used?

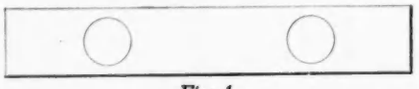


Fig. 1

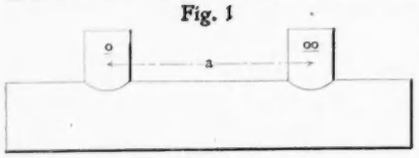


Fig. 2

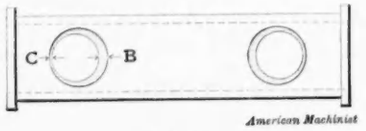


Fig. 3

HOW DOES THE CORE SWELL?

My idea is that if the pattern was made ⅛ inch shrink to the foot, the corebox should be made 1-16 inch shrink to the foot. Then when the core was ready for the mold, it would be the same length as the pattern and fit into the mold without any trouble. We all know that a core of any size, after it is baked, will not go back into the box the same as when turned out. The reason is that the flour and liquid used cause the core to swell while baking. It would be interesting to hear from others on this subject. G. H. WILLARD.

Side Planer for Wide Work—Paving-Brick Shop Floors—Grinding Cylinder Heads.

Editor American Machinist:

The improvised side planer by C. A. P., in issue of January 4, is one of the several ways to do such jobs as are too wide to pass through the machine. But the best plan I have found, and one I have used for fifteen years on a 42-inch planer, is as follows: Our company has a class of work that is too wide for this machine, and there is not enough to justify a larger planer. The bottom of the bed is planed, and we have bolted a very strong ribbed plate to it, face side up, one end projecting about 18 inches. Upon this projection we use a vertical slide similar to the cross-rail, made with a flange base, the tool slide working vertically by a feed screw with a hand-wheel at the top and a ratchet feed connected to the cross-rail feed mechanism by a rod. The slide is placed about 5 feet forward of the housings, and stayed to them by two rigid braces that can be taken down quickly. The whole appliance is taken down when not needed. It does the work as well and in the same manner as the side head of any planer. We like this device so well that we intend having it made on a new and larger planer by and by.

. . . . .

Having had extensive observation, experience and annoyance with wooden machine shop floors, I determined three years ago to try a substitute. The part of the floor where the heaviest work was done was laid with vitrified paving brick, in the same way as a first-class street. This floor has hard usage, but it is yet as good as new, and to all appearance will last for all time.

Like all good things, it has some faults. We have to be careful not to slam finished work upon it, and it is noisy for trucks; but it is so satisfactory we have floored the new shop with the same material, and will ultimately finish the old one with it. It is "a' richt."

. . . . .

Probably not every builder of engines with overhung cylinders grinds the joints between the cylinder and bed-plate—some use packing and others use a separate flange between and ground on to both. The latter comes very near the ideal, and would be perfect with the loose flange left out after grinding.

Our company has been making these engines for twelve years, big and little, with ground joints without the loose flange. We use a ring turned like the end of the cylinder, with a cross-bar cast in it. A rope is attached to the cross-bar, passed through the packing-box hole and hung over a pulley, with a weight attached. This gives the pressure, and the grinding is done the usual way. Both ends of the cylinder are ground by its own cylinder head, and the job is ready to go together. The same ring will do for any number of jobs. C. W. CRAWFORD.

Brazil, Ind.

The Blacksmith Who Had Graduated.

Editor American Machinist:

It occurred in Boston. I was running a lathe in a small shop, when a man came in with some bicycle parts that he wanted fitted up. While I was doing the work he said that if it was not a trade secret, he would like to know about the gears for cutting threads on a lathe. I gave him the desired information, and then he said: "I used to be in the blacksmithing business, but I got dissatisfied with it, and have taken up with repairing bicycles and sharpening lawn mowers and such work, a few miles out of the city. I like it much better; it's more interesting and calls for more intelligence and brains than blacksmithing. Blacksmiths are a very ignorant class of men; for if they were not, they would get out of the business, and I don't think any man with brains would stay in that business long." I did some thinking, and then I picked up a disk of steel from the lathe board and I said: "This piece of steel is 2¼ inches diameter and ¾ inch thick, or long. I got it from a blacksmith down the street this morning. He had no steel of that diameter in stock, but he took a piece of smaller size, and after cutting it to length and heating it, he placed it upon the anvil of a power hammer and upset it until it was ¾ inch long, and after swedging to straighten the sides and again flatting with the hammer it measured just the size I wanted. Now," said I, "I wish you would in return for my information about the lathe, give me the rule to use in a case like this." He said that he supposed some good men did stay in the business, but I still wait for him to return my favor.

Hugh Dolnar says, "The gas engine does not 'condense' anything." I have seen some condense a man's religion so much that he couldn't find it for some hours. FLORIN.

Attachment for Indexing to Correct Errors Caused by Elevation of Spiral Head on Milling Machine.

Editor American Machinist:

Another attachment for the Brown & Sharpe universal milling machine head, similar in principle to that described in your issue of August 31, 1899, may be used to advantage in the realignment of work held in the head when the angle of elevation has been changed.

The attachment, Fig. 1, fits the 20-hole index and engages the back pin. It divides any one of the spaces in two equal parts, thereby becoming practically a 40-hole index.

A piece of work squared with the bed when the spindle is in a horizontal position will, when the spindle is elevated 90°, or to a vertical position, be rotated a quarter turn of the index, or 2¼° of the spindle. In order to realign accurately for any degree of elevation a 360-hole index circle or its equivalent is required. This equivalent is obtained by the use of this attachment and differential movements for odd-numbered degrees, or differential movements without the attachment for even-numbered degrees.

Elevating the head any number of degrees will rotate the spindle in the same direction as will the turning of the index forward or to the right a corresponding number of degrees. For some degrees of

elevation or depression the alignment may be corrected by simple index movements, as per subjoined table:

Deg.	Turn of Index.	Deg.	Turn of Index.	Deg.	Turn of Index.
18	1 20	40	2 18	60	3 18
20	1 18	45	2 18	72	4 20
24	1 15	48	2 15	80	4 18
36	2 20	54	3 20	90	5 20

All even-numbered degrees are obtained exactly by using the 18 and 20-hole circles, the holes of the 18 circle being 20° apart and those of the 20 circle being 18° apart. Thus, turning the 20-hole index forward one hole and indexing back one hole of 18-hole circle a backward movement of 2° will be the result.

The rule and formula are given below.

The analysis of the formula is precisely the same as in the aforementioned article on milling-machine attachments. The rule is as follows:

Rule—When the elevation of the spindle is in even degrees, divide the number of degrees by 2, and the quotient will be the number of holes backward on the 18 circle and forward on the 20 circle. If the quotient is more than 10, point off the first figure for forward movement of the 20 circle and the sum of the two figures for backward movement of the 18 circle.

Example—Correction for 48° elevation: $48 \div 2 = 24$. Pointing off we have .4 for the forward movement of the 20 circle; adding the 2 and 4 we have 6 for the backward movement of the 18 circle. To prove this: 4 holes of the 20 circle is 4 times 18°, or 72°; 6 holes of the 18 circle is 6 times 20°, or 120°, and $72° - 120° = -48°$, or 48° backward.

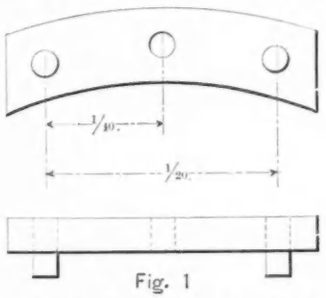


Fig. 1

INDEXING ATTACHMENT FOR MILLING MACHINE HEAD.

When the elevation spindle is depressed the movements of the indices must of course be reversed.

When the elevation or depression of the spindle is in odd degrees, point off the first figure, where there are two, taking it for the + or forward movement of the 20 circle, and the sum of both for the — or backward movement of the 18 circle. Where there is but one figure, use it for both circles.

Nine holes of the 18 circle and 10 holes of the 20 circle compensate each other when they are moved in opposite directions; for each is a half turn of the index. Let A denote the holes of the 18 circle and B the 20 circle; hence $9A = 10B$, or $9A - 10B = 0$. In other words, 9 holes forward in A less 10 holes backward in B does not change the spindle.

When the coefficient of A is an uneven number, add to or subtract from the indicated indexing the expression $9A - 10B$ and divide the result by 2. This will give the exact indexing and bring the half division on the 20 circle where the attachment is used. If the coefficient of A is an even number, divide the indicated indexing by 2 and the quotient will be the correct indexing.

Example—Required indexing for elevating head 35°. Pointing off we have 3.5. $3 + 5 = 8$, $= -8A + 5B$. $-8A + 5B \div 2 = 4A + 2\frac{1}{2}B$. Proof: $-4A = -80°$. $2\frac{1}{2}B = 45°$. $45° - 80° = -35°$.

Example 2—Depressing head from 55° to 30°. $55° - 30° = 25°$. Pointing off we have 2.5. $2 + 5 = 7$, $= 7A - 5B$. Subtract $9A - 10B = -2A + 5B$. $-2A + 5B \div 2 = -A + 2\frac{1}{2}B$. Proof: $-A = -20°$. $2\frac{1}{2}B = 45°$. $45° - 20° = 25°$.

The use of this attachment and formula will obviate all guesswork in realigning.

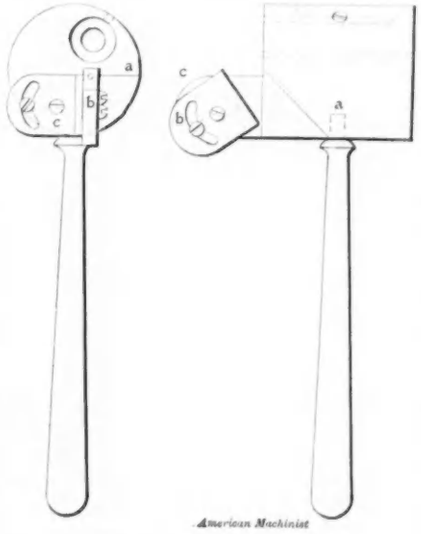
S. O. BARTLETT.

Hartford, Conn.

A Tool for Winding Springs.

Editor American Machinist:

Most shops use, for one purpose or another, more or less of coiled wire springs. Machinists are familiar with the sight of a man and a boy at a speed-lathe, one holding the spring wire while the other spaces it with a hook made of wire of the proper thickness. Slowly and laboriously it is wound on the mandrel, and is of necessity made in short lengths, with corresponding waste. It is no light job, holding ⅛-inch Bessemer spring wire while it is being coiled in this way. Noting the process above mentioned, it occurred to me that it should be superseded, and that a simple device of some kind could be used for this work to advantage.



TOOL FOR WINDING SPRINGS.

The accompanying sketch is almost self-explanatory, and shows the coiler, which now enables the boy alone to do the work which formerly required two. The spring is wound on cold-rolled stock, and this comes in lengths more than sufficient for winding a bunch of piano wire. The body of the tool, being bored large enough for the largest size likely to be required, is bushed for smaller sizes. The spacing of the spring is regulated by the piece *b* through which the wire passes. This swivels on bracket *c*, and the angle at which the wire is led to the rod determines the spacing. The hole in this piece should be just large enough for the spring wire to pass through freely. Holding the wire close to the rod on which it is wound, this rig makes an evenly spaced close spring. The tool, as shown, will make a right-hand wound spring. The end of the stock or mandrel on which the wire is to be wound is held in the chuck, the lathe spindle turns backward and the winding begins at the chuck end, the bushed hole in piece *a* fitting the mandrel and moving to the right in advance of the spring.

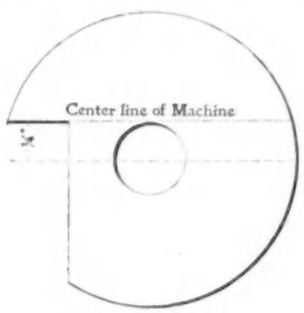
R. E. BLAIR.

Cincinnati, Ohio.

Turned Forming Tools.

Editor American Machinist:

In the "American Machinist" of November 16 I noticed an article from Mr. Wagner, "Turning Tools for Screw Machines." Being interested, I determined to notice if anyone would offer suggestions that would benefit Mr. Wagner and others using such tools. I was therefore not surprised to read in your issue of December 7 an article signed H. F. D., but cannot agree with what is said in it. Diameter has nothing to do with the cutting or standing capability of the tool in question. It is plain, or should be, that the diameter of the tool must be large enough to make the required depth of cut; also that a tool 4 inches in diameter will last longer than one of 2 inches, and cost little more to make. This is all there is in diameter. H. F. D. also says a tool set ⅛ inch above center will not turn out accurate work. This is true, for the tool would not cut at all. It would simply dig its way into the stock and be a strain on the machine. I



A TURNED CUTTER.

cannot understand how or why anyone should set such a tool ⅛ inch above center. Turning out 1,000 pieces of steel without grinding is nothing unusual. The number of pieces turned out depends upon conditions, *i. e.*, speed of machine, stock used (there is a difference in steel, oil, material the tool is made of), and last, but not least, the man tending the machine.

I have had a good deal of experience with wheel tools, and I make them of the best obtainable steel, diameter to suit the work, or as large as I can within reasonable limits; cut out the tool ¼ inch above the center and bore out the bracket ¼ inch below center of spindle on machine used. Then I set the cutting edge of the tool on the center. A bracket and tool made this way will work right and give satisfaction. G. H. M.

A New Universal Indicator.

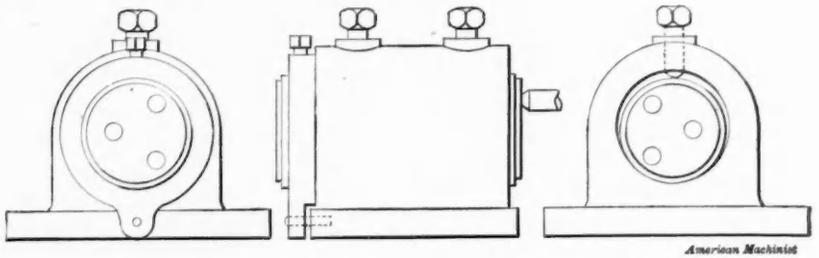
Editor American Machinist:

I have noticed in the columns of your paper, at times, descriptions and sketches of universal indicators, but have never seen anything of the kind quite so complete and accurate in its operation as the one recently brought to my notice by a machine foreman, and which, I think, will interest your toolmaker and machinist readers.

Figs. 1 and 2 show a front elevation and a vertical transverse section of the tool complete, as attached to an angular steel base and in use as a depth gage. The construction is as follows: A tubular body or shell *a*, through the center of which a rod *b* passes, and is held in any desired position by the friction collar *c*, which is slotted at *d*. The friction collar *c* is fitted free in the enlarged bore of *a* with a limited amount of longitudinal movement, and it is held in the shell by the plug *e*, which is fitted tight. The shell is cut away to give a flat surface on one side for the placing of the indicator needle and spring. Indicator needle *f* is pivoted to the shell by a small screw at *g*, the heel of the needle bearing on the friction collar *c* by the pressure of the feather spring *h*. The spring is "sweat" into a small slot in the needle, and rests against the pin *i*. The needle point is shown about in its normal position, with the friction collar resting on the plug *e*. Any upward movement of rod *b* and friction collar *c* would move the needle point to the right. Scale *j* is graduated to read approximately to thousandths of an inch, within a range of twenty-five thousandths.

The tool as applied to the ordinary surface gage is illustrated in Fig. 3. A taper hole in the body or shell at *k* provides means of attaching it to the wire rod of the surface gage. The sketch shows the operation of taking the deflections from end to end of the crossrail of a planer from the platen.

The slot at *m*, Fig. 2, may be used in connection with a steel rule or the blade of a square. The toolmaker will find many other uses for the instrument than those herein shown, such as testing a lathe center, showing the amount of wear of tool slides, leveling work in milling machine or planer, inspection of finished work, etc. The indicator may be carried in the vest pocket, its weight, without the rod, being but ¾ ounce. The inventor of this little tool is Mr. Chas. E. Hauer, a toolmaker, at present located as a milling machine floor foreman in the factory of the Westinghouse Electric & Manufacturing Company, and has been patented by Mr. Hauer. D. E. MacCarthy.



ADJUSTABLE BEARINGS FOR POLISHING-WHEEL ARBORS.

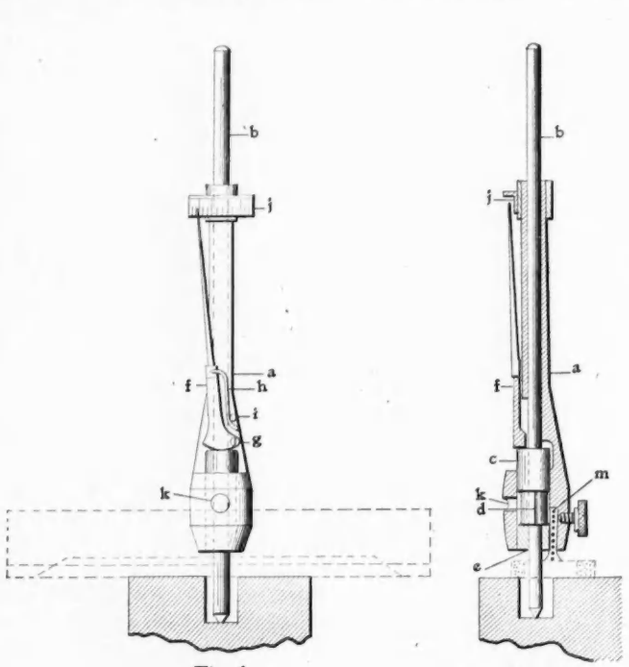


Fig. 1

Fig. 2

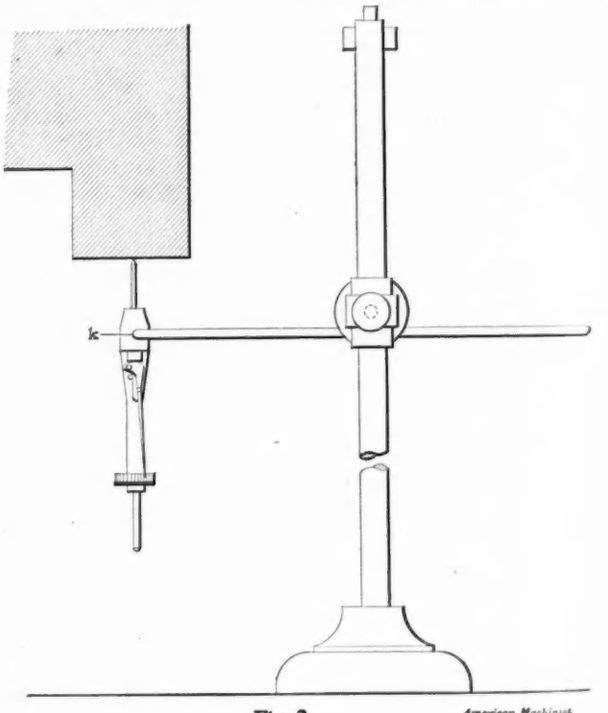


Fig. 3

A UNIVERSAL INDICATOR.

Adjustable Bearings for Polishing-Wheel Arbors.

Editor American Machinist:

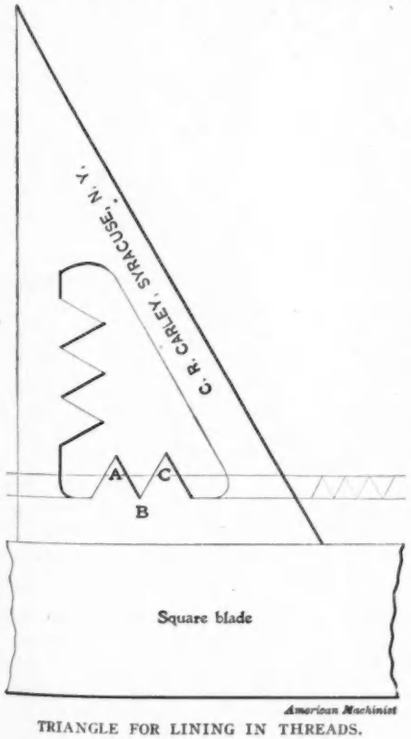
I send you some sketches of a polishing rig that I saw recently in the shops of the West Haven Manufacturing Company at

New Haven, which was new to me, and may interest you. The idea of the device is to provide ready means for tightening the belt and to increase the life of the wood center blocks in which the wheel-arbor runs, also to insure the centers always being in line.

As shown in the sketches, the pipe carrying the wood centers fits loosely in the cored sleeve on the horseshoe frame, and is secured in place by two set-screws —there being, in fact, 1-16 inch play. Tightening the belt is effected by rotating the pipe in its sleeve; thus rotating the centers about the center of the pipe, the collar on the projecting end of the pipe being loosened. When the desired adjustment is secured, the collar is again secured to the pipe and held in place relatively to the frame by the pin entering the side of the horseshoe. Increased life of the wood block is had by providing it with the three centers in each end. The pipe used is 2½ inches diameter by 6½ inches long. A. B.

Triangle for Laying out Threads.

Draftsmen know that lining in a section of screw threads is a very tedious operation, and in fact is usually avoided where possible, though sometimes it is unavoidable. C. R. Carley, of Syracuse, N. Y.,



TRIANGLE FOR LINING IN THREADS.

has devised a triangle which is especially adapted for this work, and which will do it rapidly and well. The triangle and the method of using it are shown by the accompanying engraving, and the method of using it is to draw light lines locating the top and bottom of thread, lay off one space to the desired pitch, place the triangle against the edge of the T-square as usual, place the pencil on one of the points, such as *A*, mark down to *B* and up to *C*, hold the pencil on *C* and shift the triangle to the right until it comes in contact with the pencil and then repeat the same movement. Threads are thus drawn accurately and uniformly.

The Use of Blast Furnace Gas for Power Purposes.

BY W. H. BOOTH.

It requires far too much time to overcome the inertia of precedent when a new system of working is proposed. It is now about five years since Thwaite brought out his system of utilizing blast furnace gas as a means of power production, and to-day one may almost count its applications on the fingers of two hands. The pioneer plant at Wishaw, in Scotland, has been successfully at work ever since it was started, and has, or rather ought to have, successfully proved that blast-furnace gas is a perfectly satisfactory power gas. Several plants have been started in Germany and in Belgium, and success has been uniform. Yet within the past few days, and in face of all that has been done, someone has written a letter to "The Engineer" and expressed doubts as to the possibility of using gas from blast furnaces in a gas engine. How, he asks, is it possible to thus use a gas which will sometimes scarcely ignite under steam boilers for which it is now partially utilized as a fuel? Now this writer, before entering into a technical discussion as an adverse critic, should first make himself acquainted with what has been done. Had he done so, he would have learned that whatever difficulties there maybe in utilizing poor gases, the lack of ignition is not one which affects the gas engine. Had he made himself acquainted with the facts, he might then have been led to enquire why it is that a gas so poor as not to burn under a boiler will burn freely in the cylinder of a gas engine. He would then have learned that a very weak mixture of gas and air is more readily ignited under heavy pressure than at the ordinary pressure, and that the certainty of ignition in the gas engine arises from the compression to which the explosive charge is first subjected. It is, I believe, almost entirely because men are ignorant in such details that they are unable to see and grasp important points, and valuable inventions go begging because men of capital, who will finance a charlatan like Keely, have not the knowledge to discriminate between the sound and the unsound in mechanical and physical facts. The industrial progress of America and of Germany is yet probably too new to have established a large and wealthy class who have inherited wealth but have failed to inherit intelligence. In this country we have such men. Their progenitors were abreast of the intelligence of their time, but their descendants are often abreast of nothing but a racecourse. These men have not succeeded in wrecking the undertakings they have inherited, because it requires a good deal to wreck an old-established business. They keep some sort of control on their affairs, and are often so ignorant that they are utterly unable to differentiate between what is sound in principle and what is unsound. Some things may be sound in principle and yet may not be commercially sound; but if an invention be unsound in principle, it is certainly not worth while to investigate its commercial possibilities.

In the proposal to utilize blast-furnace gas as a means of power generation, the facts which are of first importance may thus be summarized: (1) Blast furnaces are worked continuously; therefore the supply of gas may reasonably be expected to be continuous. This, of course, is a first essential to the putting down of gas engines to use such gas and distribute it as power by electrical means. (2) Even if the production of iron ceased to be profitable, the furnace may still be used to produce gas, for the gas engine is the cheapest form of heat engine, and the consumption of fuel in the blast furnace when making iron is less per horse-power of the gas generated than is the fuel consumption of the best steam engines. (3) The analysis of blast-furnace gas is so nearly identical with that of producer gas from producers specially built to produce gas for power purposes, that no doubt can exist in the mind of a man at all familiar with gas-engine practice as to the perfect suitability of blast-furnace gas, if it be allowed that producer gas is all right. In fact, it was the coincidence of the analyses of blast-furnace and producer gases that gave rise to the thought, why should this vast volume of gas be allowed to go to waste? The coincidence is *prima facie* evidence at the outset of the soundness of the principle, and, this granted, it becomes simply a question of working out details and overcoming the various difficulties which crop up. Like producer gas, the gas from a blast furnace is much poorer than ordinary illuminating gas, and the ratio of the gas and air inlets of the gas engine required modification, so as to admit more gas and less air. With the poor gases it is usually found that slightly less power can be obtained with a given size of cylinder. The combustible portion of a poor gas is from 28 to 33 per cent., the chief element of dilution being the nitrogen of the air with which the gas has been produced. The chief combustible constituent of poor gas is carbon monoxide, and where the whole of the gas produced by a furnace can be utilized, it is clear that the endeavor to make the blast furnace produce carbon dioxide is undesirable, for carbon dioxide signifies that a certain proportion of carbon has been completely burned and can be of no further use, but is rather harmful in reducing the calorific capacity of the gas, as well by the presence of the dioxide as by the increased volume of nitrogen that has been intro-

duced with the extra atom of oxygen absorbed in converting the carbon to its dioxide. Blast-furnace gas has two undesirable constituents besides the unavoidable diluent gases, which latter may be reduced to a minimum. These are water vapor and dust. Dust is variously got rid of. In some ironworks the large gas mains which carry the gas from the furnaces to its various destinations are carried not on ordinary supports or trestles, but upon vertical pipes as large as the gas main itself and open to the gas main. These pipes serve as collecting traps for dust, which can be removed from doors at the bases of the pillars. The other objectionable element—the water vapor—is removable by cooling. In Scotland, where the iron-furnaces are fed by coal instead of by coke, it pays to condense from the furnace gases, before use, all the tarry matters and ammonia. This is effected by the so-called "residuals plant," which consists of a large number of vertical iron columns cooled by the wind and by the evaporation of water which flows down the exterior of the columns. The cooling serves the double purpose of depositing the tar and the ammonia as well as condensing the water vapor. Obviously, the chief objection to the presence of water in the gas is the reduction in the volume of the gas that is drawn into the cylinder, and the consequent reduction of the power that can be developed in a given cylinder. These difficulties are worth an effort to overcome when it is considered that, according to its size, the gas output of a blast furnace may total up to 5,000 or 7,000 horse-power continuously developed. The use of the gas in an engine will return about sixfold what can be obtained from it in steam production. The gas is very inefficient as a steam producer. In the first place, the temperature produced is very low, and in the second place, the flame is of that peculiar transparent, nonradiating character that is of small effect when burned under steam boilers.

If gas power be compared with water power, it will appear evident that where the gas is already being produced it compares favorably. Very few water powers exist that do not demand considerable expenditure on the necessary dams and other headworks to make the power available. In gas power these headworks are represented by the blast furnace which has been constructed already on a paying basis of iron production. The gas engine stands in relation to gas power where the turbine of the water power stands when the head works are free. As a rule, too, the gas power is nearer some center of population than the waterfall, and requires less expenditure on transmission lines. Iron-producing countries like England or Belgium have, if they will only utilize them, a source of power compared with which the water powers, exposed to frost, of mountainous countries are not, perhaps, very economical after all. London.

Report of the Commissioner of Patents.

The annual report of the Commissioner of Patents has come to hand. It covers the entire business of the office for the year 1898. In that year there were received 33,915 applications for patents, 1,843 applications for designs, 84 applications for reissues, 1,659 applications for registration of trade-marks, 316 applications for registration of labels and 50 applications for prints. There were 22,207 patents granted, including designs, 60 patents reissued, 1,238 trade-marks registered and 200 labels and 35 prints. The number of patents that expired was 15,548. The number of allowed applications awaiting the payment of final fees was 6,824. The number that were forfeited for non-payment of the final fees was 4,363. The total expenditures were $1,136,196.20. The receipts over expenditures were $1,538.28. The total balance to the credit of the Patent Office in the Treasury of the United States on January 1, 1899, was $4,972,976.34.

In proportion to population more patents were issued to citizens of Connecticut than to those of any other State—1 to every 933 inhabitants. Next in order are the following: Massachusetts, 1 to 1,428; Rhode Island, 1 to 1,584; New Jersey, 1 to 1,594; District of Columbia, 1 to 1,694; Montana, 1 to 1,723; Oklahoma, 1 to 1,819; New York, 1 to 1,825; Colorado, 1 to 1,865; California, 1 to 1,951. The fewest patents granted in proportion to the number of inhabitants were in the following States: South Carolina, 1 to every 23,982; North Carolina, 1 to 22,787; Mississippi, 1 to 18,964; Alabama, 1 to 18,914; and Georgia, 1 to 17,333.

The figures giving the total numbers of patents granted to the citizens of each State, of course, read very differently, some of the figures being as follows: New York, 3,285; Pennsylvania, 2,172; Illinois, 1,741; Massachusetts, 1,567; Ohio, 1,472; Connecticut, 799; Hawaii, 7; Nevada, 5.

As to foreign countries, 964 patents were granted to residents of England; 634 to Germany; 345 to Canada; France, 258; Austria-Hungary, 75; Scotland, 64; Belgium, 47; Switzerland, 39; Victoria, 35; Italy and Russia, 33 each; Sweden, 32; New South Wales, 29; Ireland and New Zealand, 28 each; Denmark, 18; Netherlands, 17; Norway, 10; Mexico, 8; South African Republic, 7; Argentine Republic, South Australia and Spain, 6 each; Cape Colony, Finland, India and Queensland, 3 each; Brazil, Bermuda and Tasmania, 2 each; and to Algeria, British Guiana, Burmah, Chile, Cuba, Egypt, Guatemala, Island of Tahiti, Jamaica, Portugal, Turkey and West Australia, 1 each.

The increased force in the office has so brought up the work that for the first time in ten years the Commissioner is not obliged to ask for any addition. Of the later additions to the force the following is said:

"While no better equipped force of young men has entered the service of the Patent Office than the twenty-eight additional examiners who were added to the force last July, yet necessarily being new to the work, their efficiency for the first six months was much less than it will be from now on. . . . I cannot speak too highly of the interest taken by the examining corps in bringing up the arrears of work. When required, the examiners have cheerfully worked until 5 o'clock, and often later. There is not a more enthusiastic or loyal force in the employment of any branch of the Government service than is to be found in this office.

"The salaries paid to members of the examining corps are inadequate, and this is shown by the fact that every year more and more of the most efficient examiners resign."

A classification division has been established, which cannot fail to greatly facilitate the work of the office and to make it more thorough in detail. The number of technical journals and scientific publications relating to the industrial arts from which searches, if they are to be complete, must be made is very large. As long as a preliminary search for novelty is to be made, it is of vital importance that it should be thorough, but without a complete classification of the prior art as illustrated in patents and scientific publications it cannot be complete.

The most pressing need of the office is for additional room. This would greatly facilitate and cheapen the work of handling and furnishing copies of patents.

"The next most urgent need is for skilled stenographers and typewriters. In numbers the clerical force of this office is about sufficient at the present time to perform the work required; but the trouble is that many of the clerks entered the service before stenography and typewriting became a necessity. For example, assignments have been recorded in longhand in this office for years. Within the past few months experiments have been made with book typewriting machines, which satisfactorily demonstrate that with these machines and skilled operators not only a smaller force can do all the work of recording and in a much more satisfactory manner, but, what is also of moment in the crowded condition of the office, a saving of space required for the storage of the record books of about 40 per cent. could be made. Furthermore, every examining division should have at least one skilled stenographer and typewriter, and all copies of office records should be typewritten. Notwithstanding the technical nature of a large part of the work required of stenographers and typewriters in this office, Commissioners have tried in vain to induce Congress to pay our copyists the same salaries paid in other departmental offices. Many of our copyists receive only $720 for the same service for which copyists in other departmental offices receive $900.

The expected results from this: After a few months' service in our office many of our best stenographers and typewriters are enabled to secure transfers to offices where the smallest salary paid to copyists is $900. The position of training school is not enviable, and it is not just to this office to so adjust salaries that that result must necessarily follow!"

The Commissioner has this to say about the library of the Patent Office:

"The value of this library has been repeatedly and forcibly set forth by my predecessors. The annual appropriation for this library has for years been inadequate. I have submitted a proposition to Congress which, if favorably acted upon, will materially strengthen the condition of the library without requiring any additional expenditure of money. Authority has been asked to dispose of such works in the library as are not necessary for the work of the office, with permission to use the avails thereof in the purchase of modern works. It is hoped that this authority will be granted."

After some recommendations of amendments to the patent laws, which are mentioned elsewhere, the Commissioner concludes his report with these words:

"When it is remembered that this office is more than self-sustaining and that American inventive genius has cheapened the cost of production to the advantage of American wages, it seems as though the legislative branch of the government has done very little to encourage the useful arts and the inventors of the country. At the present time, when our manufacturers are reaching out for foreign markets, I believe no greater aid can be given them than by fostering and stimulating invention. The United States can only become dominant in the markets of the world through labor-saving inventions which will enable it to compete with the lower wages paid to the so-called working classes in other countries. The greatest development in American exports must be in the direction of increase in the export of manufactures. I assert, without fear of successful contradiction, that we mainly owe to our patent system such foothold as we have gained during the past fifty years in foreign lands for our manufactured products. We can, by a fair and liberal treatment of our inventors, control for our manufacturers not only our home markets but the markets of the world. In the words of a recognized authority, 'In labor-saving machinery and in the intelligence of the labor employed, the United States to-day is in advance of the world.' Most labor-saving machinery perfected within the last seventy-five years is the invention of our own people."

Let us not forget that it is the American inventors who by their inventions and discoveries "have made the last fifty years of the nineteenth century the most remarkable of recorded time," and at the same time have laid the civilized world under tribute. They look for a free field and fair treatment. They only ask that the money paid into the Treasury by them shall be used, so far as necessary, for the purpose of providing necessary facilities for prompt and intelligent action upon their applications for patents for their inventions. They ask no subsidies. They give more than they take. An enlightened public sentiment demands that their requests should be considered with favor by the Congress of the United States.

Special French Legislation Regarding Patents and Trade-Marks.

A new French law has just been enacted to protect the patent and trade-mark rights of foreign exhibitors during the forthcoming exposition. The regular French law allows no exhibition of an invention on French territory prior to the application for the patent. The new law allows exhibition at the exposition, and gives the inventor three months after the close of the exposition to apply for his French patent. Under the old law the importation into France of a patented article without permission of the French Government would vitiate the patent. By the new law all exhibits at the exposition are allowed to come in without danger to existing patents. Other concessions are made, and trade-marks are specially provided for. American exhibitors will incur less danger of having their trade-marks infringed in France than in this country, because the French law is exceedingly severe.

As catalogs and other printed matter will doubtless be lavishly distributed by American exhibitors, the efforts of the United States commission in securing the exemption from customs duties of all printed advertising matter is particularly gratifying. The rate—$22 per 100 pounds—was prohibitive and would have seriously detracted from the benefits expected by American exhibitors. A. F. T.

Legal Notes—An Accident in Taking Down a Shaft.

While Charles S. Knight was in the employ of the Overman Wheel Company he was engaged, with some other workmen, in taking down a piece of shafting. The piece of shafting in question was the generator shaft, and was about 17 or 18 feet long. It had upon it two pulleys—one near each end. One of these pulleys was 60 inches in diameter, with a face of 14 or 16 inches. The other was 50 inches in diameter, with a face of 25 or 26 inches. From the 50-inch pulley to the flywheel of an engine in the next room there was a leather belt 24 inches wide, and over this belt from the flywheel of the same engine there was another belt to a pulley upon another shaft, 4 or 6 feet further away from the engine than the generator shaft. The generator shaft was fastened to the ceiling of the room by means of four hangers. In order to lower the shaft a hole was cut in the floor of the room above the generator shaft, and a chain was run through this hole, one end of which was fastened around the generator shaft, and the other end attached by a catspaw hitch to chain falls suspended from the ceiling of the room above. The belts referred to were left in position. A timber strut was placed under the end of the shafting nearest the driving pulley already mentioned, and was held in position by means of a jackscrew placed underneath the timber. The object in using this timber was to raise the end of the shaft under which it was placed out of the hanger box. This object had been accomplished, and the work of lowering proceeded by letting out on the chain falls and lowering on the jackscrew. Suddenly there was a jar. The catspaw hitch gave way, the timber under the end of the shafting came out, and the end of the shafting with the driving pulley upon it came against Knight, who was working the jackscrew, thereby causing injuries to him which resulted in his death.

The widow of the deceased brought suit against the Overman Wheel Company to recover damages in the Superior Court of Massachusetts, and was awarded a judgment in her favor. The defendant urged many contentions to defeat the plaintiff's recovery, and among others that the accident was caused by the slipping of the catspaw hitch, which was made by a fellow servant of the deceased, and that after this hitch was made a half-hitch should have been made with the end of the chain, and that this would have rendered the catspaw less likely to slip. The Appellate Court held that from the evidence the jury might well have found that the side strain on the shafting caused by the belt was the cause of the accident, and that this, therefore, was no ground upon which to set aside the judgment for the plaintiff. (50 N. E. R., 890.)

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(3) C. H. R., Honesdale, Pa., asks: Is there a generally accepted angle of V-jaws for gripping round work? The smaller the diameter the more acute is the angle of V, I note in catalog cuts of pipe machines, pipe vises, etc. For example, what angle should gripping jaws be made to hold 2 to 6-inch pipe? What is the rule, please? A.—The two cuts referred to have been clipped from our advertising columns. One of them is of a Curtis & Curtis bench type threading machine, and regarding this matter the Curtis people inform us that they make the angle obtuse or flat in order that it can grip small pipes at the center without coming together at the outer portions of the jaws. The other

device is simply a pipe-holding device with jaws that interlock, the same as those of some drill chucks, and the angle therefore can be made 90 degrees, and the jaws will still grip pipes of any size within the capacity of the machine. We do not think there is any standard or recognized angle for such things. Probably 45 degrees would be adopted where there was no special reason for varying from that angle.

(4) L. M., Philadelphia, Pa., asks: How can I find the angle to give the required clearance to the sides of a tool for cutting a coarse, square thread? A.—The principle and the practice are the same, whether cutting a coarse square thread or a thread not so coarse. The peculiar feature of the case is that the angle of

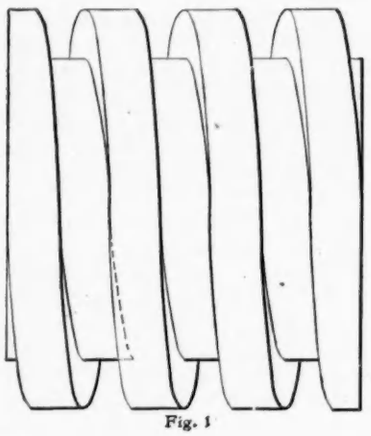


Fig. 1

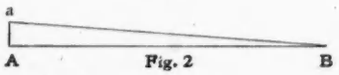


Fig. 2

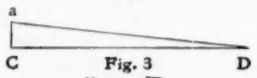


Fig. 3

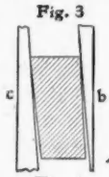


Fig. 4

pitch changes as the diameter changes, so that where the side clearance is correct at the beginning of the cutting, it becomes insufficient upon one side of the tool as the cut gets deeper, or as the cutting diameter changes. Thus in the right-hand screw, Fig. 1, it is evident that the angle of the thread is greater at the bottom of the thread than it is at the top, and the left-hand side of the tool which cuts the groove will, if it begins the cutting with just sufficient clearance, require still more clearance before the bottom of the thread is reached. If the clearance upon the right-hand side of the tool is correct when the cutting begins, it will be more than is required as the cutting proceeds, but this cannot be avoided. There will in any case be an excess of clearance upon one side of the tool at the beginning of the cutting, and upon the other side of the tool at the completion of the cutting. In cutting a nut, or an internal thread, the same effects will be experienced, but on the opposite sides. The actual angle of the thread may be ascertained as shown in Figs. 2 and 3. In Fig. 2, let the length of $A\,B$ equal the outside circumference of the screw, and $A\,a$ the linear pitch of the thread, or the distance, parallel with the axis of the screw, which the thread will advance for each complete revolution. Then $a\,B$ will represent the actual line of the thread, and $a\,B\,A$ will represent the angle at which the line of the thread will deviate from the perpendicular. In Fig. 3 the line $C\,D$ represents the circumference of the screw at the bottom of the thread and $a\,D\,C$ is the angle, which is readily seen to be greater than $a\,B\,A$. We may assume here that the thread is perfectly "square," or with the depth equal to the width, and the width of both the thread and the space the same, that the outside diameter of the screw is 3″ and the linear pitch of the screw is ¼″, which will make the smaller diameter of the screw 2¼″. The length of $A\,B$, then, will be $3'' \times 3.14 = 9.42''$, and the ratio of $a\,A$, which is ¼″, will be $.75 \div 9.42 = .0796$. $A\,B$ here being the radius and $a\,A$ the tangent, the angle $a\,B\,A$, as ascertained from a table of sines and tangents, will be 4° 34′. The smaller diameter of the screw being 2¼″, the circumference, or the length $C\,D$, will be $2.25 \times 3.14 = 7.06$; the ratio of $a\,C$ to this will be $.75 \div 7.06 = .1062$, and the angle $a\,D\,C$ will be 6° 3′. The two sides of the tool, if made to these angles, would be "line and line" with the thread at the actual cutting edge, but as the sides should have a little actual clearance, this is obtained by decreasing the computed angle on the right-hand side and increasing the angle on the left-hand side, so that the actual angles might be, say, 3° on the right-hand side of the tool and 8° on the left-hand side. Having Figs. 2 and 3 prepared, it is not necessary to go to any set of tables to ascertain the angle; a bevel or a protractor may be set directly by them, or they may be used as shown in Fig. 4, which is a section of the cutting end of the tool, looking toward the work. Fig. 2 is used for the right-hand side of the tool and Fig. 3 for the left-hand side, the outer lines *b* and *c*, of course, being vertical.

Personal.

Thos. A. Renshaw has opened an office at 75A Queen Victoria street, London, where he is handling American machine tools, and would be pleased to receive catalogs of builders of such tools.

Joseph M. Coale, master mechanic of the Baltimore shops of the Northern Central Railway Company, retires after fifty-three years of service. He was born in 1830, was a machinist's apprentice in 1846, and went to Cuba as a locomotive engineer in 1852. He entered the service of the Northern Central in 1855, and has been with that road continuously since then. He invented the Coale muffled pop valve.

Obituary.

Joseph P. Mullin, a mechanical engineer and a writer upon mechanical and engineering work, died at Arlington, N. J., January 29. He had been a member of the American Society of Mechanical Engineers since 1894, and in 1896 was elected to the New Jersey Legislature.

N. W. Boyd, manager of the Boyd Switch Stand and Signal Company, Harrisburg, Pa., died at Carlisle, Pa., February 2, fifty-six years old. Previous to the invention of the switch apparatus he had been foreman of the shops of the Pennsylvania Steel Company at Steelton.

Technical Publications.

"Centrifugal Ventilators." By J. T. Beard. 30 4¾x6½-inch pages, with six illustrations. The Colliery Engineer Company.

The above named pamphlet, which we have received "with the compliments of 'Mines and Minerals,' Scranton, Pa.," gives a mathematical analysis of the centrifugal fan, the immediate application being to large fans for mine ventilation. The discussion is thorough and the formulas are applied to an actual case.

The annual volume of "The Locomotive" for 1899, published by the Hartford Steam Boiler Inspection & Insurance Company, has been received. It fully maintains its character for conscientious work in the dissemination of important information concerning steam boilers and their management. Its report of boiler explosions in the United States for the year seems to be very close to the usual average of a little over one a day, including Sundays.

A decidedly original and attractive book is the "Pictorial History of the Locomotive," published by the Chicago Pneumatic Tool Company. The book, compiled by William Wright, comprises 81 pages, 11x10½ inches, showing pictorially and descriptively the successive locomotives, beginning with Cugnot's locomotive of 1771 for common roads, Murdock's locomotive of 1784, Trevethick's of 1803, Murray's of 1812, Brunton's of 1813, "Puffing Billy" of 1813, and so on, concluding with three of different types of 1899. The idea, happily executed, has been to present on each page a clear picture of a locomotive, occupying usually half the page, and below it a hand-written description in easily legible penmanship, thus securing a continued variety of effect. As it has thus been necessary to photo-engrave each entire page, the cost of the work, which is strongly and neatly bound, must have been considerable. Over seventy engines are shown and described. We un-

derstand that the book is being sent out very generally to the steam railroad trade, although it is entirely without advertisements or advertising suggestion. The name of the Chicago Pneumatic Tool Company appears in modest type upon the cover, and also upon the title page as publisher.

Our esteemed correspondent, Mr. Tecumseh Swift, writes to The New York Times that if ladies had their right arms cut off they would invariably face forward when alighting from a street car, because they would then have to use the left hand to guide and steady themselves. The reasoning by which this chunk of wisdom was evolved leads him to propose the running of street cars upon the left-hand tracks and with single track lines to allow passengers to get off only on the left side. This might be worth trying.

Minister Bryan, Petropolis, Brazil, writes to the Department of State that the San Francisco Railroad (Estrado de Ferro de S. Francisco) in the State of Bahia, 281 miles long, wants catalogs of iron structures. Mail direct to Hon. Charles Page Bryan, envoy extraordinary and minister plenipotentiary of the United States, Petropolis, Brazil.

Manufacturers.

A sewing machine factory is expected to locate at Gloversville, N. Y., in the spring.

The Bristol Knitting Mill Company has been organized at Bristol, Tenn.; capital, $100,000.

A company organized at Findlay, O., has bought the Findlay rolling mill, not operated for years, and the plant will be put in operation about March 15.

A Western capitalist will in the spring construct another large shoe factory at Calais, Me. A company has been formed to build large shipbuilding docks.

(*Continued on page* 46.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 20.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

D'ftsmen's novelties. D.J.Kelsey,N.Haven,Ct.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 8.)

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies & Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale—Two geared Ferracute presses, 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Wanted—One horizontal cylinder boring machine, in first-class condition; size about 42 inches. Address, with particulars, to the Harrisburg Foundry & Machine Works, Harrisburg, Pa.

Wanted—One second-hand punch that will punch 2-inch hole in 1-inch stock; one second-hand jib crane, hand power, 10 tons capacity. Advise condition with dimension, Climax Road Machine Co., Marathon, N. Y.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—Tenders for the construction of machines in quantity; machines weigh about 6,600 lbs., and shop should have a planer 42 in. wide and a 30 in. lathe, and must be fitted for general machine work, including such fine work as is required for weighing devices; also would like to hear of a shop fitted for doing such work that might be leased or purchased. Box 161, AMER. MACH.

The patents, patterns and special tools of a new high-grade special machine lately patented in the United States and Europe will be sold out shortly; price $25,000; 13 of these machines have been sold within 15 months and give entire satisfaction; the gross profits on same amount to $10,486; this is a splendid addition to the business of any large machine concern, as there is a steady demand for these machines. For investigation and details address Box 160, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Skilled toolmaker, with 15 years' experience, wants work. Address Box 180, AMERICAN MACHINIST.

Wanted—Position as foreman patternmaker, or permanent position at the bench. Box 175, AMERICAN MACHINIST.

Foremanship of iron foundry, by foreman, experienced on engine and general jobbing work. Box 135, AMERICAN MACHINIST.

Mechanical draftsman is open for position; assisting engineer or outside work preferred; 10 years' experience. Box 174, AMER. MACH.

Wanted—Position, by practical foundry foreman; machinery or jobbing; Eastern States. Address Box 179, AMER. MACHINIST.

Mechanical engineer (30), 15 years' successful experience in machine-tool line, open for responsible position. Box 181, AM. MACH.

As assistant superintendent, by a technical graduate, familiar with up-to-date shop management; 10 years' experience. Address Box 171, AMERICAN MACHINIST.

Machinery salesman, experienced, German, French and Spanish, desires position traveling here or abroad; references, present employer. C. Daly, 87 W. Columbia st., Detroit, Mich.

Position with concern desirous of reducing costs, by man acquainted with modern economical manufacturing methods; familiar with piece-work systems. Address Box 172, AMERICAN MACHINIST.

Position wanted in manufacturing concern; have had 15 years' experience in office and management; familiar with bookkeeping and all details of office work, buying, selling, etc. Box 170, AMERICAN MACHINIST.

Position wanted as head foreman, by thorough mechanic, used to general machinery, dynamos, tools; tools designed for close interchangeable work; can handle men to best advantage. Address Box 783, Orange, N. J.

Mechanical engineer, 31, graduated in Germany, expert in gasoline and kerosene engines, familiar with the designing of special tools, 5 years' experience in automobiles here and abroad, wishes to change. Box 177, AMERICAN MACHINIST.

A practical mechanic, age 32, who has filled the position of superintendent in a small factory building a line of light machinery, desires to correspond with party who can offer a position with chance of advancement. Address Box 178, AMERICAN MACHINIST.

Toolmaker of ability and long experience on automatic screw machinery and tools will shortly be open for engagement; expert on caming labor-saving tools for anything made in rod stock; accustomed to handling men, and a cost reducer. Box 1811, Bridgeport, Conn.

American, 27, good education, 10 years at the trade, last 2 as foreman machinist of marine engine building shop running 80 to 90 men, wants responsible place with concern building air compressors and heavy engine work; salary a decided object; references. Address replies to Box 173, AMER. MACHINIST.

Mechanical expert and draftsman, age 35, healthful, energetic, wide experience, including automobiles, superior inventive ability, can equip and superintend any size plant, knows the money-making machines and tools, close buyer, systematic, economical, trustworthy, wants permanent position; will go anywhere; reasonable salary; finest references. Box 176, AMERICAN MACHINIST.

Help Wanted.

Wanted—Young man having had some experience in mechanical drawing. Box 147, AMERICAN MACHINIST.

Twenty first-class machinists wanted; steady work. Address Weber Gas & Gasoline Engine Co., Kansas, Mo.

Wanted—Young men to learn engraving by mail; send for circular. Home Engraving School, Box 1,171, Springfield, Mass.

Good machinists wanted on stationary and marine engines. Write to Box 182, AMERICAN MACHINIST, stating experience and salary wanted.

Foreman molder wanted on good machine castings in green and dry sand, to compete with the market in quality and price. N. B., 703 Beard Building, New York.

Wanted—2 draftsmen for structural work, with practical experience. Apply by letter only, stating age, reference and compensation, to Thomas A. Edison, Orange, N. J.

Wanted—Reliable, accurate draftsman experienced in machine-tool and jig work; state qualifications, references and wages expected. The Bickford Drill & Tool Co., Cincinnati, O.

Wanted—Agents who are acquainted with machinery manufacturers, to obtain machinery for exhibition and export; high commission paid. Albert H. Linz, P. O. Box 2923, New York City.

Wanted—2 or 3 first-class general machinists on light tool making, small auto. machinery, jigs, fixtures, etc.; state age, experience and wages expected. Address Box 156, AMERICAN MACHINIST.

Wanted—Foreman for machine shop, not over 35; active, energetic man with experience with machine tools; give record, reference and salary desired. Address Box 159, AMERICAN MACHINIST.

Wanted—As head foreman, a thoroughly reliable mechanic who can handle men and work to advantage; we build special machinery and presses of every description. Box 113, AMERICAN MACHINIST.

Wanted—Draftsman familiar with mill design, heavy machinery, etc., about 65 miles from St. Louis, Mo.; state age, experience and salary expected. Address "Construction," care AMERICAN MACHINIST.

Wanted—First-class mechanical engineer and draftsman; one who has had large experience in electric traveling cranes preferred; good salary and permanent position. Box 149, AMERICAN MACHINIST.

Wanted—3 or 4 good machinists and 1 sheet iron worker for regular work in machine shop; good pay and steady work to competent men. State age and experience to Kenney & Co., Scottdale, Pa.

Modern brassworker in globe valves; temperate; must give reference for ability and character; state wages desired and whether able to control men; good position to right man. "Valve," AMERICAN MACHINIST.

Wanted—An experienced man to take position of chief cost clerk of foundry and machine shop, manufacturing a special line of air compressors and appliances, employing at present about 200 men. Address P. O. Box 237, Milwaukee, Wis.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Competent draftsman with experience on machine tools and hydraulic machinery; young man, technical graduate preferred; give experience, reference and salary desired; good opening for right man. Address Box 158, AMERICAN MACHINIST.

A young mechanical engineer who has had experience in compressed-air machinery, and who is competent to take charge of designing a line of medium-sized air compressors; a permanent position for the right man; references required. Address Kent, care AM. MACH.

(*Continued on page* 46.)

The Stephens & Westcott Company, of Maywood, Ill., has purchased land and is building a machine shop, 52x128 feet, and foundry will be erected in the spring.

The power-house of the Street Railway Company, Fredonia, N. Y., which recently was destroyed by a wide-spread fire at that place, will be rebuilt as soon as possible.

The Monolith Portland Cement Company (Limited), Battle Creek, Mich., has filed articles of incorporation, with a capitalization of $2,500,000. The company will erect and operate a large Portland cement plant at Bristol, Ind.

The Bennington & Hoosick Valley Railway Company (office at Hoosick Falls, N. Y.) has commenced the construction of a power plant, which is to be fitted with all mouern equipments. It is expected to have the new plant in operation by May 15.

William Steele & Sons, Philadelphia, Pa., have filed plans for a four-story and basement manufacturing building for the Moss Rose Manufacturing Company, at Allegheny avenue and Hancock street. The building will measure 54x152 feet, with a wing to be 54x40 feet. The wing will contain the engines and boilers, pumps, etc.

G. F. Payne & Co., 401 South Juniper street, Philadelphia, Pa., are estimating for Architect Guy King, 433 Walnut street, on the one-story brick and iron foundry building to be erected for the DeKoseno Manufacturing Company, of that city. The owners will install special power machinery and apparatus as soon as this is completed.

The Federal Cement Company has been formed under West Virginia laws (capital stock $5,000,000) to manufacture Portland cement in Virginia and Tennessee. The company has acquired over 25,000 acres of valuable rock deposits in those States suitable for the manufacture of Portland cement, and intends to operate factories at once.

At the annual meeting of the stockholders of the Berlin Iron Bridge Company held at the office of the company, in East Berlin, Conn., on Monday, the 29th ult., the capital stock was increased to $750,000. The following Board of Directors was elected: Chas. M. Jarvis, Frank L. Wilson, S. H. Wilcox, H. H. Peck, Geo. H. Sage. D. E. Bradley and Seymour N. Robinson.

The American Brass Manufacturing Company has been incorporated in New Jersey; capital, $500,000. It is understood it is organized for the purpose of continuing the manufacturing business of the Henry McShane Manufacturing Company, of Baltimore, Md. At the same time there was incorporated the F. W. Webb Manufacturing Company (capital, $250,000) to continue the jobbing business of the Henry McShane Manufacturing Company, in Boston.

The Union Traction Company awarded the contract for the construction of its central power-house, which is to be located in Anderson, Ind., and will furnish the power to operate the whole system. The contract was let for $88,698. O. L. Pulse & Co., of Greensburg, secured the stone work, etc., at $61,198, and the Indiana Bridge Company, of Muncie, the iron and steel work for $22,500. The building must, under the terms of award, be in readiness for the machinery by June 1.

The Morse Iron Works & Dry Dock Company was incorporated at Albany January 27, with a capital stock of $550,000. It is designed to be an enlargement of the Morse Iron Works, located at the foot of Twenty-sixth street, Brooklyn. The company is stated to have options on a large strip of land from First avenue to the channel, along the water

(*Continued on page 47.*)

Help Wanted—Continued.

Wanted—First-class machinists, familiar with floor work in erecting heavy pumping engines, hoisting engines and air compressors; good wages; steady work; modern equipped shop. Apply in person, Fraser & Chalmers, 12th st. and Washtenaw ave., Chicago, Ill.

Wanted—Foreman for machine shop employing 100 men; must be well up on best modern shop practice and capable of reducing "dead" expenses, as well as cost of product; give age, experience and salary desired; confidential. Address "New," care AMERICAN MACHINIST.

Wanted—First-class, up-to-date mechanical superintendent for large boiler shop, machine shop, foundry and smith shop; able to take complete charge of engineering, purchasing and manufacturing; must be up on modern practice and capable of reducing direct costs and unproductive expenses; give experience, age, salary and full particulars. Address, in confidence, "Superintendent," care AM. MACH.

Wanted—By Alfred Herbert, Ltd., of Coventry, England, a first-class man as chief inspector, to take charge of the inspecting and testing of hand and automatic screw machines, turret lathes, milling machines, small tools, etc., etc.; a good opportunity for the right man. Apply direct as above, giving particulars as to age, experience and salary required. The above firm are also in need of one or two first-class small tool draftsmen and designers. We should be pleased to receive applications for these positions from capable men. Owing to the distance, applications should be as complete as possible.

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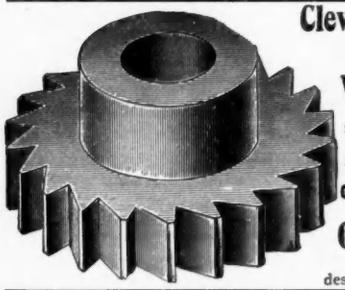

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